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INTERNATIONAL CONFERENCE IN EDUCATION AND REGIONAL DEVELOPMENT

TRANSFORMING EDUCATION *Through* CURRICULUM DEVELOPMENT

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SAMBUTAN

A BRIEF NOTE of the Proceeding of the 6th International Conference on Education and Regional Development (6th ICERD) held on November 27th 2025

This is the proceeding of the 6th International Conference on Education and Regional Development (6th ICERD) held on November 27th 2025. As the chairman of the Indonesian Curriculum Developers Association (HIPKIN), it is an honor for me to address a brief note on the Proceeding of the 6th International Conference on Education and Regional Development (6th ICERD).

The event is one-yearly International Conference that was held in collaboration between Puskurjar BSKAP Kementerian Pendidikan Dasar dan Menengah (Kemendikdasmen), Himpunan Pengembang Kurikulum Indonesia (HIPKIN) and Program Studi Teknologi Pendidikan dan Pengembangan Kurikulum Fakultas Ilmu Pendidikan Universitas Pendidikan Indonesia.

We are really thankful to Puskurjar Kemendikdasmen and Prodi Teknologi Pendidikan and Pengembangan Kurikulum UPI which have fully supported to this conference with the theme is "*Transforming Education Through Curriculum Innovation in the Digital Era*".

This proceeding consists of 53 papers. Some topics are among other, as followed: Curriculum innovation for transformative and future ready education; Digital pedagogy and emerging technology; Meaningful and joyful learning; Teacher empowerment & leadership; Inclusive and equitable curriculum for all. The presented paper were the compilation ideas, result research findings and expertise of presenters and participants that have been shared and presented of their best practice and experiences during the conference.

It is hoped this proceeding of 6th ICERD would contribute beneficial for developing education system in Indonesia.

Bandung, January 2026

Prof. Dr. Dinn Wahyudin, M.A.
(*The Chaiman of HIPKIN*)

KATA PENGANTAR

Puji syukur kami panjatkan ke hadirat Tuhan Yang Maha Esa atas tersusunnya buku prosiding *Seminar Internasional ICERD ke-6* bertema "*Transforming Education Through Curriculum Innovation in the Digital Era*" yang telah dilaksanakan pada 27 November 2025 di Kota Bandung. Kegiatan ini merupakan hasil kerja sama Program Studi Pengembangan Kurikulum, Himpunan Pengembang Kurikulum Indonesia, serta Pusat Kurikulum dan Pembelajaran BSKAP Kemendikdasmen sebagai wujud komitmen bersama dalam mendorong transformasi pendidikan melalui inovasi kurikulum di era digital.

Buku prosiding ini memuat 53 judul artikel yang merepresentasikan beragam hasil penelitian, kajian konseptual, studi literatur, serta praktik baik dari akademisi, peneliti, dan praktisi pendidikan. Secara substantif, keseluruhan artikel merefleksikan lima tema besar yang saling berkelindan, yakni inovasi dan pengembangan kurikulum; transformasi pembelajaran berbasis teknologi digital dan Artificial Intelligence; penguatan kompetensi serta kesiapan pedagogis guru; implementasi pendekatan pembelajaran mendalam yang bermakna, berkesadaran, dan menggembirakan; serta penguatan kebijakan, evaluasi, dan kepemimpinan pendidikan abad ke-21. Kelima tema tersebut menggambarkan lanskap perubahan pendidikan yang tidak hanya menekankan aspek struktural kurikulum, tetapi juga dimensi pedagogis, teknologi, dan pengembangan kapasitas manusia secara holistik.

Integrasi teknologi digital termasuk AI, *coding, extended reality*, dan kerangka pembelajaran mendalam dalam berbagai artikel menunjukkan bahwa inovasi kurikulum pada era digital menuntut perubahan paradigma pembelajaran yang lebih adaptif, reflektif, dan berorientasi masa depan. Pada saat yang sama, perhatian terhadap literasi data, kesiapan guru, resiliensi akademik, *growth mindset*, serta budaya belajar yang etis dan inklusif menegaskan bahwa transformasi pendidikan yang bermakna harus bertumpu pada penguatan kualitas pendidik dan pengalaman belajar peserta didik. Dengan demikian, prosiding ini menghadirkan dialog akademik yang komprehensif antara kebijakan, teori, dan praktik pendidikan.

Seluruh artikel dalam buku ini telah melalui proses seleksi dan penyuntingan sesuai standar akademik yang berlaku. Kami menyampaikan apresiasi dan terima kasih kepada para narasumber, pemakalah, reviewer, mitra kerja sama, serta seluruh panitia yang telah berkontribusi dalam penyelenggaraan seminar dan penyusunan buku ini.

Sebagai Ketua Pelaksana sekaligus Penanggung Jawab Editor, kami menyadari bahwa buku ini masih memiliki keterbatasan. Oleh karena itu, kami terbuka terhadap masukan dan saran yang konstruktif demi penyempurnaan publikasi di masa mendatang. Kiranya

prosiding ini dapat menjadi referensi akademik yang bermanfaat dan memberikan kontribusi nyata bagi pengembangan kurikulum serta transformasi pendidikan yang berkelanjutan di Indonesia maupun pada konteks global.

Bandung, Januari 2026
Ketua Pelaksana & Penanggung Jawab Editor

Dr. Yulia Rahmawati, M.Si.

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Developing a Transformative Religious Curriculum A Case Study of Adolescents' Cognitive Dissonance and Faith Resilience

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ABSTRACT

Rapid social change has intensified cognitive tension among Indonesian Muslim adolescents when doctrinal Islamic Religious Education (IRE) fails to align with their lived realities. This study explores how adolescents experience and make meaning of such dissonance and how faith resilience emerges within the IRE context. Using Interpretative Phenomenological Analysis (IPA), three public high school students were selected through purposive criterion sampling. Data were generated through 45 – 60 minutes semi-structured interviews and analyzed thematically with NVivo, guided by religious orientation theory, stages of faith, religious coping theory, and cognitive dissonance theory. Findings show that students face significant tension between normative teachings and modern social realities. Those with intrinsic or reflective faith orientations employed active religious coping and reinterpretation of teachings, leading to stronger spiritual resilience. In contrast, extrinsically oriented students tend to suppress doubts, resulting in superficial learning. The study's small sample and single-site context limits transferability but underlines the need for more dialogical and student-centered IRE,

Keywords: *Critical Thinking, IRE Curriculum, Reflective, transformative learning*

1. INTRODUCTION

The Islamic education landscape is undergoing profound transformation under globalization and social change. As Saepudin (2022) observes, the rapid expansion of digital technologies and global connectivity has unleashed secular and materialist currents that often conflict with traditional religious teaching (Saepudin, 2022). Sitti & Rosyalita (2025) similarly note that digitalization and shifting sociocultural norms "Threaten to eradicate the distinctiveness of Islamic pedagogical systems," compelling educators to modernize curricula while preserving core values (Sitti & Rosyalita, 2025). In a globalized society that increasingly prioritizes secular, skill-based learning, Islamic institutions face the dual challenge of upholding their spiritual heritage and remaining relevant. Indeed, researchers warn that if Islamic schooling does not address issues like digital literacy, pluralism, and socioeconomic inequality, it risks marginalization, meanwhile the rising specter of extremism and identity crises among Muslim youth underscores the need for education that fosters a balanced contextually grounded religious understanding.

The pressure is amplified in multicultural context. One of the research describes Western societies, where schools must teach students to navigate heterogeneity and ambivalence (Yagdi, 2025). Yet such societies have also witnessed political narratives

that link "Muslim" with "terrorist" in public discourse (Rahmat, 2022), adding stigma and confusion for young Muslims. In this post-secular milieu, Muslim adolescents regularly encounter conflicting messages. Modern mass media and pluralistic peer environments expose them to diverse worldviews, so that inherited religious norms may clash with the realities of their daily lives, for example secular social norms and alternative moral frameworks) (Chaerodin & Asdiqoh, 2023). This dynamic often places adolescents in a state of cognitive dissonance, tensions between childhood religious inculcation and contemporary experience, prompting many to critically scrutinize and sometimes question their faith.

Recent studies confirm that traditional one-way models of religious socialization are in flux. Babacan (2025) argues that today's youth enjoy greater autonomy and access to information than previous generations, consequently, received religion is frequently brought under critical scrutiny (Babacan, 2025). Many young believers, having been raised under strict conservative norms, later encounter pluralistic and secular influences that lead them to re-evaluate those teachings, sometimes resulting in periods of doubt or even disaffiliation (Beider, 2023). In sum, globalization has produced both challenges and opportunities, while Muslim youth can draw inspiration from a global ummah, they almost have to negotiate the conflicting demands of modern life.

In response to these trends, Islamic educators have begun calling for pedagogical reforms. Rather than rote, teacher-centered instruction, scholars emphasize student-centered and dialogical approaches that actively engage learners. Contemporary educational theories such as self-determination theory hold that student autonomy, relatedness, and competence foster intrinsic motivation. The previous research report that "Innovative and student-centered methods that encourage active participation, reflective thinking, and contextual relevance" significantly improve Muslim students' motivation and learning (Wahyuni et al., 2024) In particular, dialogical pedagogy which emphasizes mutual inquiry, perspective-sharing, and linking religious concepts to real-life context is seen as a way to revitalize Islamic studies. Tambak et al. (2025) highlight that deep, participatory dialogue resonates with the Islamic tradition of al-hiwar (constructive debate) and can both sustain students' faith and enhance moral reasoning (Tambak et al., 2025) . By drawing students into discussion and personal reflection, these methods aim to make religious education more meaningful and resilient to secular pressures.

Taken together, the literature suggests that Islamic religious education must adapt to the digital and pluralistic age. Educational frameworks are needed that integrate spiritual values with scientific literacy, that encourage critical engagement, and that support young people in internalizing their beliefs. In light of this background, the present study investigates how early religious socialization, encounters with doubt,

and coping strategies influence adolescents' faith retention. We analyze the phenomenological experiences of Muslim youth to identify which factors promote enduring commitment to Islam, thereby offering insight into pedagogies for nurturing resilient faith in an era of social change.

2. METHODOLOGY

2.1 Research Design

This study uses an interpretive phenomenological analysis approach to explore the subjective experiences of Muslim adolescents facing cognitive dissonance when religious teachings are perceived as inconsistent with the realities of their lives (Smith et al., 2009) . Interpretative phenomenology was chosen because it allows researchers to deeply access the participants' inner meaning-making processes, religious conflicts, and reflective dynamics. This approach aligns with the research objective, which focuses on the essence of personal experience, rather than on evaluating broader systems or institutional contexts.

2.2 Participants of the Study

The research was conducted at a public high school in Indonesia. Participants were selected using purposive criterion sampling, with the following criteria: (1) Muslim; (2) aged 16-18 years; (3) experienced value conflicts and dialectics regarding religious teachings. The small number of participants is not a methodological limitation, because interpretative phenomenological analysis emphasizes in-depth analysis of individuals, not numerical representativeness. In the interpretive phenomenological tradition, 3-5 participants are considered ideal for producing a range of experiential accounts that can be analyzed in depth.

2.3 Data Collection

Data were collected through 50 – 60 minutes in-depth semi-structured interviews. The interviews focused on students' internal experiences, including the conflict between childhood religious experiences and modern life, feelings of dissonance, personal reflection, religious coping strategies, and changes in religious orientation. All interviews were audiotaped with the participants' permission and later transcribed verbatim.

2.4 Data Analysis Techniques

The analysis follows the steps of *interpretative phenomenological analysis:* (1) Familiarization, namely reading the transcript repeatedly to understand the nuances of the experience; (2) Initial noting, making detailed notes related to emotional, linguistic, and conceptual statements; (3) Development of emergent themes, namely identifying patterns of meaning, subjective experiences, and moments of dissonance; (4)

Identification of superordinate themes, connecting initial themes into a broader structure of meaning; (5) Integration between cases, namely identifying similarities and differences in the experiences of the three participants (Smith & Osborn, 2015).

The interpretation process is supported by four theoretical frameworks: (1) Religious Orientation Theory helps categorize participants' religious motivations; (2) Stages of Faith Theory is used to assess the development of faith and changes in adolescents' spiritual orientation; (3) Religious Coping Theory is used to understand the psychological tension that arises when religious teachings are perceived as contradictory to real-life experiences; and (4) Cognitive Dissonance Theory.

2.5 Data Validity

Several strategies were implemented to ensure the credibility of the research, including: (1) Member checking, where participants reviewed a summary of the findings to ensure accuracy of meaning; (2) Triangulation, using three sources, namely interview transcripts, researcher reflection notes, and the dynamics of participant emotions that appeared during the interview; (3) Reflexive journaling, where researchers noted biases, self-positions, and personal assumptions that could influence interpretation; (4) Audit trail, where the entire coding and analysis process was documented using NVivo so that it could be traced back.

3. RESULT AND DISCUSSION

RESULT

Researchers mapped the findings using NVivo *software*, edition 14. All three informants stated that they experienced cognitive dissonance between what they had learned about religious values during their childhood and the realities of their daily lives. This was experienced as they became teenagers. Based on Figure 1, the person who experienced the most cognitive dissonance was informant 1 (hereinafter referred to as N1). N1 began comparing the concept of belief in God between Islam and other religions, due to a lack of understanding of the reasons behind her religious commands, one of which was related to the concept of the hijab. N1 felt that the hijab had no impact on women's safety, as cases of harassment against women who wore covering clothing were often encountered. Another concept that made N1 anxious was the conflict between the need for affection from the opposite sex during adolescence and the prohibition on dating in Islam. During her adolescence, this left her confused about what to do. In addition to these two concerns, N1 also experienced turmoil regarding the truth of Islamic teachings, because, for her, there were too many sources with conflicting findings.

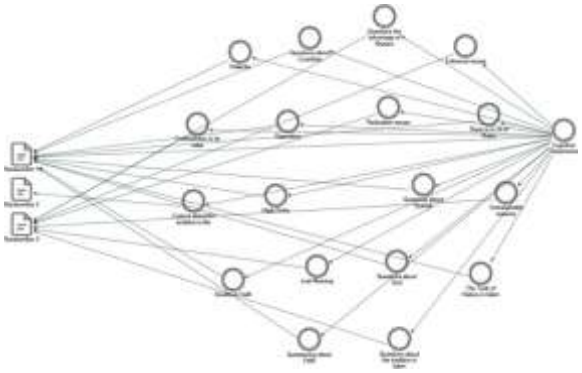

Figure 1. Cognitive Dissonance towards Religious Beliefs

Interviewee 3 (later referred to as N3) also experienced considerable cognitive dissonance. N1 focused more on contradictions within Islamic teachings, such as issues of tolerance within the concept of Islam. N3 highlighted the observed reality of many seemingly radical individuals within the Muslim community. Consequently, he experienced cognitive tension regarding the understanding that Islam is a religion that brings peace, but the reality does not demonstrate a linear relationship. Further dissonance arose regarding the meaning of the purpose of human life on earth. These questions often left him feeling lost, as he did not understand the ultimate outcome of his efforts or hard work.

An interesting point illustrated in Figure 1 is that Interviewee 2 (hereinafter referred to as N2) experienced very little cognitive dissonance. N2 simply asked questions and expressed curiosity about life's problems that could be resolved using the principles of the Quran. N2's responses demonstrate his belief that Islamic teachings can provide solutions to life's problems, a desire he sought to scientifically prove.

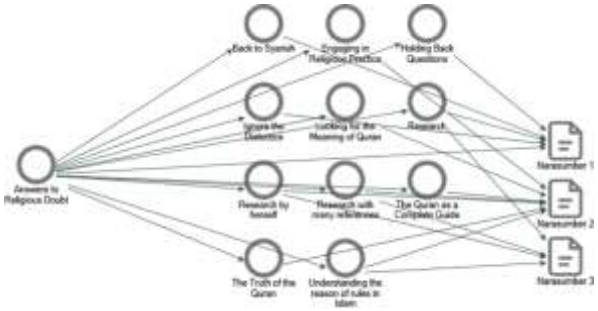

Figure 2. Respondents' Responses to Doubts in Religion

As they entered adolescence, all three informants acknowledged that questions related to their beliefs began to emerge. These questions often gave rise to cognitive dissonance and doubt, as described in Figure 1. These questions were met with a variety of responses by the three informants. N1 tended to refer his anxiety to religious narrative texts. While N1 attempted to explore the dissonance, the intensity was minimal. N1 preferred to suppress his anxiety, ignore it, and return to the established

rules. In contrast to N1, N2 varied in his approach to resolving religious questions. N2 often conducted independent research, used various internet sources, or consulted teachers he considered knowledgeable. N3 also shared a similar tendency to conduct independent research and consult experts who could explain the issue scientifically. Therefore, when he encountered numerous questions related to Islamic commandments, the first step he took was to establish a paradigm that understood the meaning and purpose of each commandment.

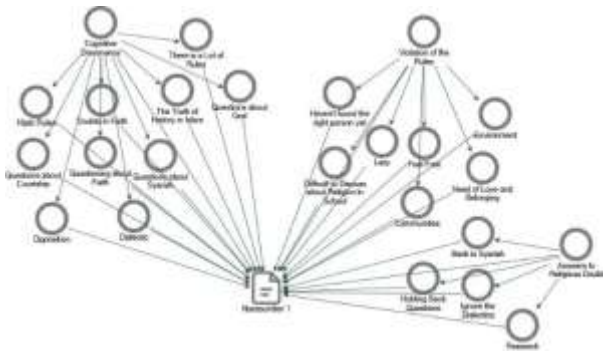

Figure 3. Challenges in Implementing Religious Law

Next, the researcher explored the informants' personal experiences in practicing religious law. Based on Figure 3, N1 felt the challenge stemmed from laziness, believing that Islamic teachings had too many rules, leading to a feeling of reluctance to be restrained. This reluctance made him slightly more willing to violate God's commands. Another factor was that N1 felt that it was rare to find someone who could adequately address his concerns. Thus, in N1's case, environmental factors influenced his attitude in practicing religious rules. N2's challenges were usually caused by the difficulty of consistently practicing good deeds due to laziness and environmental factors, but N2 responded by re-examining the benefits of the religious behavior he was practicing. Unlike the two previous informants, N3 faced challenges in carrying out religious commands when he did not understand the reasons behind them. When N3 could not understand scientifically, it was difficult for him to continue practicing the law. This challenge was exacerbated by the difficulty of finding people with whom to discuss religion within his school environment.

DISCUSSION

Analysis based on Religious Orientation Theory

The differences in cognitive dissonance and behavioral *output* were analyzed by researchers using a psychosocial approach. The first approach employed the Religious Orientation theory, which, according to Allport and Ross, divides religious orientation into intrinsic and extrinsic. Intrinsic orientation is based on the interpretation of religion as a life goal. Extrinsic orientation, on the other hand, defines religion as a means of non-spiritual attainment. In the context of N1, he exhibited extrinsic characteristics; he

performed family rituals and those taught in religious schools, but struggled to connect them with personal meaning, often feeling constrained. Conversely, N2 grew with a depth of intrinsic motivation; he actively discussed and explored the Quran and Hadith, and experienced inner peace as a result of his devotions. N3 underwent a transition; initially, he was extrinsically obedient, but then shifted toward an intrinsic orientation after successfully finding a logical explanation that resolved his doubts. In N2, the characteristics of this religious orientation were evident in the way religious values shaped their entire worldview and code of ethics, as well as their earnest efforts to internalize and fully practice their religious beliefs. Even though at first N2 did not know the benefits of the religious practices he was carrying out, he continued to explore the issue until he understood the meaning and found peace.

The first informant has a religious tendency with an extrinsic orientation. Another characteristic that is apparent is a fear of "sin" as a consequence of not following religious commands. This is evident in N1's hesitation regarding the conflict between following God's command not to *"come close to adultery"* and the dilemma of gaining attention from the opposite sex. Although N1 ultimately chooses to adhere to religious teachings, this basis is based on a fear of sin and a fear of being labeled negatively by those around him. The consequence of this religious orientation is a fragility, where he does not hesitate to again violate God's prohibitions when his emotional feelings (lust) dominate. According to Allport, the strength of faith can be assured if an individual orients his religion intrinsically.

Analysis based on Stages of Faith Theory

Fowler's model articulated in *Stages of Faith: The Psychology of Human Development and the Quest for Meaning* (1981) emerged from interdisciplinary research that blended theology, psychology, and sociology (Hopson, 2009). Influenced by Jean Piaget's theory of cognitive development and Lawrence Kohlberg's stages of moral development, Fowler postulated that faith follows a predictable trajectory. (Fowler, 2017).

Researchers identified N1 as occupying *stage 3* in the Stages of Faith theory, namely the *Conventional Faith stage*. This third stage usually begins when the transition to formal operational thinking, allowing a person to reflect on their thoughts and analyze contradictions in the story (Neuman, 2011). N1 showed in the case of historical narratives, he felt that there were differences between one source and another in Islamic History that raised questions about which of these differences was correct. N1 was able to analyze these differences because, in this stage, he could work through hypothetical situations, work with symbols, be idealistic, and tend to be judgmental.

Individuals in stage 3 can step outside the box, see new connections, and form new relationships. Because adolescence is a time of personal growth and the search for identity (Fowler, 2017). This process of searching for identity is very strong seen in the turmoil that occurs in N1, where he is unable to understand the purpose of his existence in this world. On the other hand, in the conventional faith stage, they really want God to accept them and affirm their identity. That is why in the case of N1 when there is inner turmoil about emotional experiences (feelings of love for the opposite sex) that violate religious rules, he wants to feel that God "understands" his behavior with forgiveness, because he feels the need for love for the opposite sex is part of nature.

In contrast, N2 is at stage 4, namely Individuative-Reflective, within Fowler's (1981) framework. One characteristic of faith development at this fourth stage is demonstrated by a critical examination of previously held beliefs. This is particularly evident in N2, particularly when he practices *voluntary fasting*. Initially, N2 only knew that voluntary fasting was a good recommendation, but then he engaged in critical thinking by exploring the health and psychological benefits of fasting. Thus, N2 not only accepted but also reviewed, compared, and adjusted his understanding of religion within his own rational framework. Meanwhile, N3 also went through a transitional process between the two stages, namely doubting mechanical rituals (such as the tradition of reciting the Yasinan on Friday nights, or other worship practices), which was then followed by a reflective effort that led to a more personal and critical understanding of faith.

Analysis based on Coping Religious Theory

Coping theory can be defined as an individual's attempt to overcome problems by maximizing what is valuable or important to them. In this context, the source of value can be psychological, social, physical, material, or spiritual. In this context, *religious coping* has a significant impact on resilience. *Religious coping* can provide comfort, stimulate personal growth, increase a sense of closeness to God, facilitate closeness with others, or offer meaning and purpose in life.

According to Pargament, religion can provide many ways for its followers to gain control in overcoming life's problems, such as: (1) Self-Directing, (2) Deferring, (3) Collaborative. The *self-directing method* emphasizes personal responsibility and the individual's active role in problem-solving. In this context, God gives individuals the freedom and resources to direct their own lives. *Deferring, on the other hand,* places the responsibility for problem-solving on God. Rather than actively solving their own problems, the person tends to wait for solutions from God. The last method, Collaborative, reflects the shared responsibility for problem-solving by God and the individual.

In a study by Pargament, these three ways of obtaining religious coping have different implications for mental health. Self-directing and collaborative are associated with higher levels of emotional intelligence, while deferring is associated with lower levels of competence (Pargament & Brant, 1998). Thus, based on Pargament's research findings, people who have religious coping through self-directing and collaborative methods are individuals who are better prepared to face the demands and dynamics of life, because they have good emotional control over these problems.

Based on the findings, N1 often shows a deferring style, in the midst of academic and social pressure, he prefers to submit to rituals and surrender rather than actively seeking meaning. (Dein, 2013). Thus, even when he was in difficult times, N1 still had good thoughts about God and believed that what happened to him was the best thing for him, according to God's version of goodness. However, this deferring coping pattern has various challenges when faced with contradictions between teachings and individual desires that have not been successfully reconciled (experiencing cognitive dissonance). Based on research (Pargament & Brant, 1998), people with deferring coping tend to have lower emotional intelligence.

N2 demonstrated a collaborative coping style, reflecting a shared responsibility for problem-solving by God and the individual (Pargament & Brant, 1998). N2 combined prayer, reading, and concrete actions such as researching religious literature to resolve her personal problems (Bone & Dein, 2021) . This was demonstrated by her behavior of continually studying the contents of the Quran and interpreting them in a way that was easy for her age to understand. The results of this study process gave rise to a deeper understanding of the compassion and love shown by Allah through the Quran, thus increasing her confidence in her actions to remain steadfast in Islamic values. This aligns with the theory of Religious Coping, which suggests that spiritual coping can provide comfort (Wolkinson & Weinberg, 2023). and stimulate personal growth with God (Koenig, 2018), especially if the process of forming a sense of comfort with God is carried out actively.

N3 went through a transitional process between the two stages, with doubts about rituals followed by a reflective effort that led to a more critical understanding of faith. Within Pargament and Koenig's theoretical framework, N2 progressed through the Self-Directing stage, characterized by an emphasis on personal responsibility (Pargament & Brant, 1998) and the individual's active role in problem-solving (Koenig, 2018). In this context, God grants individuals the freedom and resources to direct their own lives. N3 is a highly active individual who seeks the meaning of every command and ritual he performs. For him, this meaning must be understood logically and scientifically. This awareness stems from N3's logic: the more a person understands the rationale for a command, the more consistent he or she can be in carrying it out. When

faced with failure, N3 does not simply blame God's destiny; he actively seeks to correct his mistakes.

Analysis based on Cognitive Dissonance Theory

Cognitive dissonance, introduced by Leon Festinger in the 1950s, is a psychological phenomenon that occurs when an individual experiences discomfort due to holding conflicting beliefs, attitudes, or behaviors (Kaminska & Sznajd-Weron, 2020). This discomfort often leads to stress, guilt, or anxiety when, for example, these beliefs and actions are inconsistent. In response, individuals may change their beliefs, justify their actions (Harmon-Jones & Mills, 2019), or avoid conflicting information to reduce tension. People experiencing cognitive dissonance are more likely to change their cognitions, behaviors, or perceptions of their behavior (Arman et al., 2025).

Festinger stated that the inconsistency between beliefs and behavior creates dissonance that triggers balancing efforts (Miller et al., 2015). N1 faced religious dissonance with passive obedience to avoid guilt. N2 hardly experienced serious dissonance because the religious material he studied was always in line with his knowledge experience, facilitating resolution and strengthening his faith. N3, who was doubtful about the tactical rules, resolved the dissonance by asking for rational explanations, a form of cognitive accommodation that deepened his understanding (Harmon-Jones & Mills, 2019).

N1 and N3 experience the most shock, but each of them resolves it in a different way. N1 tends to act to reduce cognitive dissonance by changing cognitions. from the conflict that occurred in a more positive way (Kaminska & Sznajd-Weron, 2020), while in N3 initially there was a change in perspective on religious teachings themselves, viewing religion as something that can be explained logically. This change in perspective in N3 ultimately changed his behavior towards religion, from initially apathetic and skeptical, to reconciled and increasingly convinced that the religion he adheres to can align with the context of the modern era.

However, when linked to the Stages of Faith theory, cognitive dissonance will indeed occur at the ages of N1, N2, and N3 considering the cognitive development as well (Fowler, 2017). Therefore, the conflict between old knowledge and new knowledge that has been acquired is not something to be afraid of. The occurrence of cognitive dissonance, if followed up in a balanced, appropriate, and objective manner, actually has a positive impact (Yahya & Sukmayadi, 2020). Conversely, when not addressed appropriately, it can build the meaning that religion is restricting one's life (Miller et al., 2015), and has implications for behavioral *output* that is highlighted not in accordance with religious rules.

Efforts to Develop Religious Education Curriculum in Secondary Schools

The phenomenon of the Society 5.0 era, characterized by an abundance of digital information, poses a major challenge to preserving the faith of adolescents. Islamic education must respond to the emergence of this new society with innovative breakthroughs. Adolescents are now often portrayed as easy targets for secular culture, which can erode their faith. A study by Elsafir (2024) revealed that the negative impact of digital media is quite significant, with many adolescents experiencing a decline in religious understanding, necessitating efforts to internalize a strong religious understanding (Elsafir, 2024). Similarly, IDN Times (2025) emphasized that the faith of Muslim adolescents is often exposed to social media distractions and foreign values, which, if not anticipated, can erode their religious foundations (IDN, 2025). The findings of this case study indicate that in the context of such pressures, critical reflection on faith, active *coping strategies* (initiatively seeking understanding), and religious motivation that grows from within (an intrinsic approach) play a major role in maintaining adolescent faith.

These findings can be explained by theories of education and developmental psychology. According to Vygotsky's constructivism theory, religious knowledge and values are constructed through social interaction and meaningful discussion. Nurhayani et al. (2024) demonstrated that constructivism-based Islamic Religious Education (PAI) learning is conducted collaboratively, with the teacher acting as a mediator, guiding students in understanding religious concepts through discussion and interaction (Nurhayani et al., 2024). With this approach, adolescents are encouraged to develop critical reflection and personal meaning in religious teachings, rather than simply passively accepting dogma.

Meanwhile, the humanistic approach places students at the center of value development. Islamic humanism emphasizes personal integrity, self-actualization, and mutual respect among students. Qoyimah & Hamami (2025) emphasized that humanistic learning in Islamic Religious Education (PAI) can foster strong social attitudes, mutual respect, and togetherness (ukhuwah Islami) because teachers focus on students' individual potential, not just cognitive aspects (Qoyimah & Hamami, 2025). Thus, intrinsic religious motivation is more likely to develop in a supportive classroom environment that respects the uniqueness of each student.

Furthermore, Fowler's theory of faith development emphasizes that adolescence is in the synthetic-conventional stage, where beliefs are still heavily influenced by figures in the social environment. For example, a study by Marisa et al. (2023) found that parents, peers, and spiritual mentors are important mentors for adolescents in developing their faith. This means that Islamic Religious Education (PAI) curriculum and learning need to provide space for the role of religious facilitators (teachers, parents, friends) to guide students toward a more personal and mature understanding of faith. A dialogical approach, which invites adolescents to analyze spiritual experiences and

religious values in their lives, will facilitate a shift from "conventional faith" to a more independent, "individual-reflective" stage of faith.

Within the framework of the Independent Learning Curriculum, Islamic Religious Education (PAI) transformation must integrate the values of the Pancasila Student Profile, such as faith and piety, and critical thinking. Maulidik et al. (2025) emphasized the importance of a holistic approach in the independent PAI curriculum, developing not only teaching content but also the culture and learning system to align with the values of independent learning and the Pancasila Student Profile. The application of innovative learning methods and digital technology is seen as having great potential in creating contextual and humanistic religious education. Thus, the recommendations for a transformative high school PAI curriculum encompass several aspects, as shown in Figure 7 below:

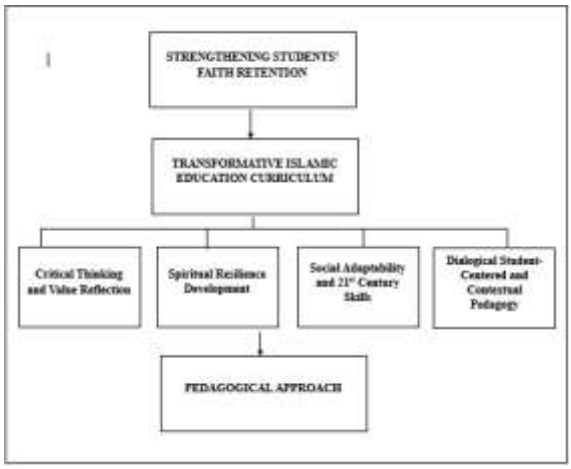

Figure 4. Transformative Curriculum Development at IRE

The curriculum transformation in IRE can be explained as follows: (1) Strengthening critical thinking and value reflection that can encourage students to explore the meaning of Islamic teachings in their personal and social contexts; (2) Developing spiritual resilience through active coping, such as seeking social support in religious communities, engaging in discussions, and utilizing positive Islamic content in digital media to foster intrinsic faith; (3) Social adaptability and 21st-century skills, where the curriculum must equip students with creative and adaptive thinking skills; and (4) A dialogic and student-centered pedagogical approach, which provides space for students to express their questions and experiences of faith. The teacher in this context plays the role of facilitator.

Overall, the urgency of transforming the high school Islamic Religious Education (PAI) curriculum is very high to maintain the relevance of religious education in the digital era. By integrating research findings on factors supporting adolescent faith resilience into curriculum design, transformative PAI programs can produce a generation of young people who are critical thinkers, value-sensitive, spiritually

resilient, and adaptive. Developing a holistic, contextual and dialogical curriculum will equip students with future skills while strengthening their faith foundations amidst ever-changing social dynamics.

4. CONCLUSION

This study found that Muslim adolescents frequently experience cognitive dissonance when the doctrinal content of Islamic Religious Education (IRE) conflicts with their personal and social realities. Many students described tension and doubt as they encountered modern social norms and behaviours that seemed at odds with traditional teachings. Importantly, those with intrinsic or reflective orientations toward faith confront these tensions by actively seeking understanding, engaging in questioning, research, and reinterpretation of teachings, which appear to strengthen their spiritual resilience. In contrast, participants with more extrinsic orientations tended to suppress or ignore their doubts, relying on rote compliance and resulting in a more superficial engagement with religious content. These patterns suggest that active, critical engagement can foster deeper faith resilience, whereas passive acquisition may leave underlying questions unresolved. However, these findings should be interpreted with caution due to the study's limitations. The research involved a very small, purposive sample of three students from a single school, which limits the generalizability of the conclusions. The specific cultural and educational context may have influenced the results, highlighting the need for future research in more diverse settings. Additional studies with larger and more varied samples will be necessary to confirm and extend these insights into how adolescents negotiate dissonance in IRE. Taken together, the results underscore important implications for IRE curriculum development. A more dialogical, student-centered curriculum can explicitly address students' questions and real-life concerns, thus fostering faith resilience through open dialogue. Educators should incorporate critical thinking exercises and opportunities for reflection, helping students to connect religious teachings with contemporary challenges. Practical strategies might include integrating discussions of current social issues from an Islamic perspective or assigning research projects on the relevance of religious principles as ways to deepen understanding. By creating learning environments that value inquiry and multiple perspectives, IRE can help young Muslims internalize their beliefs meaningfully while equipping them to navigate the pluralistic, digital era with confidence

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Implementation of a Dual Curriculum for Strengthening Students' Numeracy Competence: A Mixed-Methods Case Study

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ABSTRACT

Numeracy is a key 21st-century competency that enables students to apply mathematical understanding in real-life contexts. However, despite continuous curriculum reforms, Indonesian students' numeracy performance remained below international standards as shown in national and global assessments. Limited studies had explored how the integration of international curricula contributed to improving numeracy learning in Indonesian schools. This study analyzed the implementation of a dual curriculum integrating the Indonesian National Curriculum and the Singapore Curriculum and its impact on strengthening secondary students' numeracy competence. A mixed-methods approach with a case study design was employed at a private high school in Pekanbaru that consistently applied both curricula. Data were collected through an AKM-based numeracy test, in-depth interviews, classroom observations, and document analysis of curriculum and textbooks. The findings revealed that students were strong in procedural skills, particularly in algebra, but still struggled with reasoning, mathematical communication, and open-ended problem solving. These challenges were influenced by limited reading literacy, dominance of procedural exercises, and insufficient exposure to contextual problems. Document analysis showed that the Singapore Curriculum emphasized problem solving and spiral content structure, while the Indonesian Curriculum focused more on conceptual mastery and logical thinking. The study highlighted the need to strengthen reasoning-based and contextual numeracy learning through adaptive textbooks, continuous teacher training, and reflective teaching practices within dual curriculum implementation.

Keywords: *curriculum implementation, dual curriculum, mathematics learning, numeracy competence*

1. INTRODUCTION

Numeracy is a key 21st-century competency that enables students to solve contextual problems. Yet Indonesian students continue to perform at low levels. Results from the Asesmen Kompetensi Minimum (AKM) and PISA 2022 show that most remain at the basic level of mathematical literacy (OECD, 2023b), indicating ongoing challenges in implementing the secondary mathematics curriculum. Numeracy outcomes are shaped not only by curriculum quality but also by teachers' pedagogical competence (Nugraheni & Jailani, 2020).

Singapore presents a contrasting profile. About two-fifths of its students reached Levels 5–6 in PISA 2022 (OECD, 2023a), and TIMSS 2019 consistently placed Singapore at the top in lower secondary mathematics (Mullis et al., 2020). These results

align with its curriculum, which positions mathematical problem solving as the central instructional focus (Ministry of Education Singapore, 2021).

Several Indonesian schools have attempted to improve numeracy by integrating elements of international curricula. One school in Pekanbaru implements a dual curriculum combining the National Curriculum with Mathematics subjects based on the Singapore curriculum. This arrangement requires teachers to reconcile two curricular frameworks and students to adapt to more demanding numeracy expectations. To examine these dynamics, this study employs a mixed-methods approach using numeracy assessments, interviews, observations, and curriculum document analysis.

Studies on numeracy, representation, and statistical reasoning have been conducted in Indonesia (Supriadi et al., 2023; Viryanto & Kismiantini, 2024; Yuntari & Hamdi, 2024), but they rarely address the implementation of international curricula or their integration into local practice. This study therefore investigates how curriculum policy, teaching practices, and numeracy outcomes interact within a dual-curriculum context.

The novelty of this research lies in its analysis of the combined implementation of the Indonesian National Curriculum and the Singapore Curriculum in secondary mathematics. It compares curricular frameworks, examines classroom practices along with teacher and student experiences, and analyzes numeracy test results that were developed in line with the AKM model. The findings aim to support the development of adaptive pedagogical strategies and responsive curriculum policies.

This study addresses three questions:

1. What is the profile of students' numeracy competence across domains, cognitive levels, and item formats?
2. How do teaching practices and teacher–student experiences reflect dual curriculum implementation?
3. What key differences exist between both curricula, and what implications do they hold for enhancing numeracy competence?

2. METHODOLOGY

This study employed a sequential explanatory mixed methods case study design. Quantitative data were collected first using an AKM aligned numeracy test to examine students' numeracy performance, followed by qualitative data collection to explain and contextualize the quantitative findings. The case study was conducted in a private senior high school in Pekanbaru selected purposively due to its dual curriculum implementation, namely the Indonesian National Curriculum and the Singapore Curriculum, and its strong numeracy outcomes.

The population comprised students and mathematics teachers at the selected school. For the quantitative phase, one class was selected through simple random

sampling, and all students in the class participated in the numeracy test. For the qualitative phase, purposive sampling was used to select mathematics teachers, two students representing high and moderate numeracy achievement, and the vice principal for curriculum affairs. Curriculum documents and mathematics textbooks from both curricula were included as secondary data sources.

The primary quantitative variable was students' numeracy performance, operationally defined as the ability to apply mathematical knowledge across content domains and cognitive levels. Numeracy performance was measured across Geometry and Measurement, Algebra, and Data and Uncertainty at the Knowing, Applying, and Reasoning levels. The main instrument was a researcher developed numeracy test aligned with the AKM framework, comprising multiple choice, complex multiple choice, true and false, matching, short answer, and open ended items. Content validity was established through expert review, and reliability was examined using internal consistency measures.

Quantitative data were analyzed descriptively, while qualitative data were analyzed using Miles and Huberman's interactive model. Integration occurred through triangulation to generate an explanatory understanding of factors influencing students' numeracy performance within the dual curriculum context.

3. RESULT AND DISCUSSION

Student' Numeracy Profile

Numeracy test results from 25 eleventh-grade students showed that Algebra achieved the highest mean score (66.6), followed by Data & Uncertainty (61.2), while Geometry & Measurement was lowest (57.0) (see Figure 1). This confirms earlier evidence that geometry and spatial representation remain relatively weak domains for Indonesian students (OECD, 2019, 2023c).

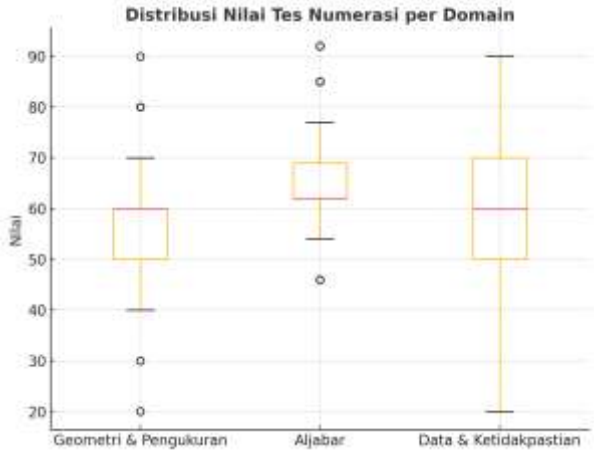

Figure 1. Distribution of Numeracy Test Scores by Domain

At the cognitive level, students scored highest on Knowing (72.4), slightly lower on Applying (71.2), and markedly lower on Reasoning (45.3) (see Figure 2). This pattern

indicates strong procedural fluency but limited higher-order reasoning, consistent with PISA and TIMSS findings (Mullis et al., 2020; OECD, 2019; Supriadi et al., 2023).

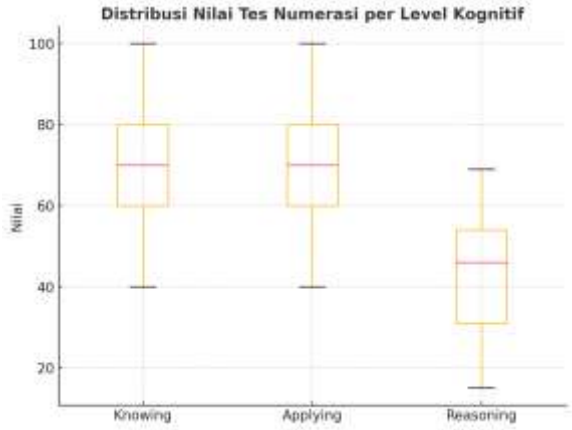

Figure 2. Distribution of Numeracy Test Scores by Cognitive Level

By item type, students performed best on multiple-choice (83.2) and complex multiple-choice (75.6), moderately on true–false (69.6) and matching items (58.8), and weakest on short-answer (50.1) and open-ended items (20.3) (see Figure 3). Low performance on open ended tasks indicates that students experience difficulty expressing their mathematical thinking in written form (Ministry of Education Singapore, 2021; OECD, 2023a), confirming Viryanto & Kismiantini's (2024) findings about weak argumentation when responding to open response items. Oktiningrum et al. (2016) therefore stress the need for PISA-type, locally contextualized items to cultivate argumentative thinking in Indonesia.

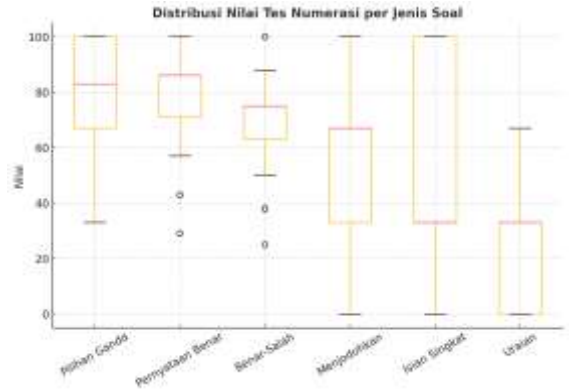

Figure 3. Distribution of Numeracy Test Scores by Item Type

Overall, these results suggest that students are more habituated to closed-format and routine tasks, while reasoning and communication remain underdeveloped (Setiawan, 2019). Although the school has implemented a Singapore-based curriculum that strengthens procedural and algebraic skills, the central challenge is still to foster mathematical reasoning and numeracy literacy through open-ended and argumentative activities (Lindorff et al., 2019; Rezat, 2024; Ministry of Education, 2021; OECD, 2023).

Student Interview Findings

Interviews with two students who completed the numeracy test offer contextual support for these patterns. Both students perceived the test as moderately to highly challenging. Student 1 attributed the difficulty to forgotten content, whereas Student 2 reported greater confidence but pointed out that some three dimensional area items contained incomplete information. These responses underscore the importance of clarity and completeness in test stimuli (Oktiningrum et al., 2016).

Both students agreed that interpreting texts, images, and tables was more challenging than performing calculations. Student 1 struggled with long texts requiring sustained concentration, while Student 2 found diagrams harder to interpret. These difficulties mirror OECD (2019, 2023b) findings on challenges in processing visual and verbal representations. Geometry was seen as the most difficult domain, not only because of formula recall but also due to limited conceptual understanding, consistent with TIMSS evidence of Indonesian students' weaknesses in contextual geometry (Mullis et al., 2020). Student 2 further reported that true–false items were cognitively demanding because each statement had to be evaluated separately, aligning with the lower quantitative performance on this format.

Both students reported some exposure to AKM-style questions since Grade 10 but at limited frequency. They recognized that such items require more analytical and critical thinking than routine exercises, consistent with the higher-order aims of the AKM framework (Ministry of Education Singapore, 2021). Despite difficulties, both expressed positive attitudes towards mathematics: Student 1 enjoyed geometry's imaginative aspects, while Student 2 preferred computation and found geometry less engaging. These positive dispositions are in line with Russo & Minas (2020) and Wen & Dubé (2022), who argue that students may still enjoy mathematics when they experience it as "challenging yet rewarding."

Finally, both indicated that instruction needs to be more varied and interactive, with technology integrated through explanations, group work, digital quizzes, and multimedia, while also acknowledging that poor technology management may cause distractions. Such recommendations support Gustafsson et al. (2024), who emphasize the need to adapt instructional media to sustain classroom effectiveness. Overall, the interviews reinforce that numeracy challenges stem from conceptual and procedural demands, stimulus and context interpretation, and limited exposure to diverse problem formats.

Classroom Observation Findings

Classroom observations were used to connect learners' reported challenges with actual teaching practices. Lessons typically began with greetings, a short prayer, and

an apperception activity that linked prior knowledge to the day's objectives, consistent with the principle of cognitive readiness (Tak et al., 2025).

During the main phase, the teacher facilitated small-group discussions in which students read and interpreted problem stimuli and presented their solutions. These activities encouraged metacognitive processes in which students evaluated peer strategies and reflected on their accuracy. (Firmansyah et al., 2025). The teacher provided scaffolding when students encountered difficulty, thereby extending their Zone of Proximal Development in line with research showing the benefits of metacognitive interventions and scaffolding for mathematical literacy and proportional reasoning (Kholid et al., 2025; Murtafiah et al., 2024).

The lesson closed with a reflective summary, jointly constructed by teacher and students, to consolidate key ideas and connect them to subsequent material. This finding is consistent with the meta analysis by Muncer et al. (2022), which demonstrates a positive association between metacognitive processes and mathematical performance. Collectively, interviews and observations show that major challenges include interpreting complex stimuli, especially in geometry, and limited experience with contextual numeracy tasks. Meanwhile, students' procedural strengths and positive attitudes are supported by interactive teaching that remains largely procedural.

Teacher and Vice Principal Interview Findings

Interviews with the mathematics teacher and vice principal clarify the curricular and institutional context. The school follows the national curriculum while also adopting the Singapore curriculum, taught in English. Although content overlaps, the national curriculum is more theoretical, whereas the Singapore curriculum emphasizes application, literacy, and earlier introduction of statistical topics such as histograms, which supports progressive reasoning development (Lindorff et al., 2019; OECD, 2023c). The vice principal explained that the dual curriculum aims to strengthen students' international competitiveness in PISA, TIMSS, and mathematics olympiads, consistent with Jin & Chen (2023). The Singapore curriculum is implemented via an additional Mathematics subject of three instructional hours per week.

Lesson planning for both Matematika and Mathematics is conducted at the beginning of the year through teacher meetings and internal training. External experts are invited to enrich teaching approaches and develop more realistic, contextual problems, in line with findings on PISA-based tasks and numeracy literacy (Oktiningrum et al., 2016). Classroom assessments use multiple choice, true and false, matching, and essay questions, and consistent exposure to text based and context based items in school examinations has contributed to strong AKM numeracy performance. As a result, this school records the highest level of numeracy literacy in

Riau Province. However, the teacher noted that around 80% of students still prefer asking the teacher to reading long texts themselves, pointing to reading literacy limitations that affect numeracy, especially on items requiring data interpretation from texts, tables, or graphs (OECD, 2019; Supriadi et al., 2023).

Institutionally, the school supports curriculum implementation through teacher professional development, visits from consultants and external speakers, and benchmarking with national and international schools (Nugraheni & Jailani, 2020; Gustafsson et al., 2024). Regular communication with parents further strengthens student learning, consistent with evidence on the role of parental support (Wang et al., 2023). Teacher performance evaluations are followed by competency enhancement programs, echoing recommendations in teacher evaluation literature (Rajadurai, 2023). An internal research team uses assessment data to guide innovations in contextual learning that link mathematical concepts to real life contexts, as recommended by Viryanto & Kismiantini (2024). These efforts are reinforced by the use of Singapore based textbooks, digital platforms, and the proficiency of teachers and students in English and Mandarin, which expands access to international learning resources (Mullis et al., 2020a).

Overall, the interviews show that high numeracy outcomes are underpinned by the synergy of curriculum policy, classroom practice, teacher development, research-based innovation, and a collaborative school culture, creating a reflective and contextually grounded learning ecosystem.

Mathematics Textbook Analysis Findings and Local Adaptation Needs

Document analysis of *New Discovering Mathematics*, the Singapore-based textbook used in Mathematics, examined how far learning resources align with the intended contextual approach. The book is systematically organized and aligned with international trends, yet several challenges arise in the Indonesian context: many problem situations are not closely connected to students' daily lives, and numerous mathematical terms originate from external contexts. This is consistent with Revina (2021), who warns that adopting Realistic Mathematics Education without local adaptation can produce linguistic, cultural, and pedagogical barriers.

From a curriculum resources perspective, textbooks are part of a broader ecosystem that must align with teachers' practices and students' experiences (Rezat, 2024). Thus, textbook development and selection should consider not only content but also contextual fit. Studies by Sunzuma & Umbara (2025) and Oktiningrum et al. (2016) underline the importance of integrating culture and technology, through ethnomathematics and PISA-like problems rooted in Indonesian cultural heritage, to increase relevance and strengthen students' connection with learning contexts. The analysis therefore confirms that numeracy enhancement depends on curriculum design,

classroom practice, and the school's capacity to adapt global materials to local cultural and linguistic realities.

Indonesian and Singaporean Curriculum Comparison Findings

A comparative analysis of the Indonesian and Singaporean secondary mathematics curricula further clarifies how curricular orientation shapes numeracy competencies. The Indonesian national curriculum stresses conceptual understanding, logical reasoning, and adaptive skills (Ministry of Education Singapore, 2021), but research indicates that it continues to place limited emphasis on applications drawn from real life. By contrast, Singapore's curriculum is explicitly oriented toward mathematical problem solving and application (Kaur, 2014), fostering higher order thinking and mathematical literacy.

These differences are evident in textbook and task design. Singaporean textbooks prioritize investigative and operational approaches (Nurhikmayati et al., 2025), employ more contextual and visual tasks (Purnomo, 2024), and adopt exploratory task designs even in introductory topics such as sets (Hendriyanto et al., 2023). The Singaporean curriculum is systematically structured around concepts, skills, processes, metacognition, and attitudes (Sumliyah et al., 2025) and aligns with international assessments in which Singaporean students consistently outperform Indonesian students in reasoning and problem solving (Mullis et al., 2020; OECD, 2019, 2023c). High-performing systems also embed values such as integrity and systematic thinking in mathematics learning (Serçe & Acar, 2021). Content mapping by Ayu & Wijaya (2022) shows that Singapore applies a spiral curriculum design, with topics revisited and deepened over time, while Indonesia tends to cover major topics within a single year. This spiral structure supports the gradual building of deeper conceptual connections, which is crucial for sustained numeracy development.

To further clarify how these curricular orientations translate into structural and pedagogical differences, the key features of the Indonesian and Singaporean secondary mathematics curricula are summarized in Table 1. The comparison highlights contrasts in overall goals, content organization, embedded values, learning approaches, textbook characteristics, and the positioning of mathematical literacy, providing a clearer picture of how each system frames and supports the development of students' numeracy competence.

Table 1. Comparison of the Indonesian vs Singaporean Mathematics Curricula

Aspect	Indonesia	Singapore
General Orientation	Emphasizes conceptual understanding, logical, analytical, and systematic thinking, as well as adaptability in daily life (Merdeka Curriculum).	Emphasizes mathematical problem solving as the core of the curriculum, with a strong focus on real-world application and problem solving.

Aspect	Indonesia	Singapore
Content Distribution	Major topics are completed within a single academic year (e.g., algebra, geometry, trigonometry, statistics), with calculus introduced in Grades XI–XII.	Topics are distributed progressively through a spiral curriculum, developing skills from basic to advanced levels over time.
Curricular Values	Emphasizes discipline, independence, patience, perseverance, and rational thinking. Integrity is not explicitly stated.	Emphasizes perseverance, open-mindedness, and integrity as integral values in mathematics education.
Learning Approach	Mentions problem solving and project-based learning, but classroom practice remains largely monodisciplinary within mathematics.	Problem solving and project-based learning are implemented collaboratively and across disciplines, including the integration of applied mathematics.
Text books	Contain numerous verification and non-applicative problems, with a stronger theoretical focus.	Rich in visual representations, contextual problems, operational investigations, and mathematical modeling tasks.
Mathematical Literacy	Not yet an explicit framework within the curriculum, though introduced through the Minimum Competency Assessment (AKM).	Mathematical literacy is integrated as a core competency framework encompassing concepts, skills, metacognition, and attitudes.

Overall, students demonstrated relatively strong procedural skills, particularly in algebra, tasks at lower cognitive levels, and closed format items, while their reasoning, communication, and open ended problem solving abilities were less well developed. These challenges can be attributed to gaps in conceptual understanding, limitations in reading literacy, restricted experience with contextual problems, and differences in curricular structure. The implementation of a dual curriculum indicates that strengthening numeracy depends on alignment among instructional practices, assessment approaches, textbook adaptation, and institutional support.

4. CONCLUSION

This study shows that students possess strong procedural numeracy but weak reasoning, especially in Geometry & Measurement and in open-ended item formats. Their stronger performance on closed format tasks, together with their difficulties in interpreting texts, diagrams, and contextual information, addresses the first research question concerning students' numeracy profiles. Classroom observations and interviews further reveal that dual curriculum implementation supports procedural fluency but offers limited opportunities for learning that emphasizes reasoning. Students' challenges are reinforced by reading-literacy demands, while curriculum comparison shows that the Singapore curriculum's problem-solving and spiral progression differ markedly from Indonesia's more conceptual coverage. These

differences help explain how teaching practices and curricular structures shape the experiences of teachers and students, thereby addressing the second and third research questions.

In light of these conclusions, teachers are encouraged to incorporate more open-ended and contextual tasks, including PISA-like problems, and to explicitly teach strategies for interpreting written and visual information to strengthen reasoning. Schools should enhance professional development that focuses on metacognitive scaffolding and literacy-integrated mathematics instruction, while curriculum developers and policymakers need to revise materials and guidelines to support culturally grounded tasks that emphasize reasoning. Through coordinated improvements in classroom practice, curriculum design, and institutional support, students can develop numeracy proficiency that is both procedurally sound and contextually meaningful.

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Learning from The Didactic Transposition Process: Insights for Curriculum Improvement in Geometry Education

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ABSTRACT

This study investigated the gap between the scholarly knowledge and understanding of pre-service mathematics teachers in geometry, specifically on the topic of angle pairs formed when two lines were intersected by a transversal. This gap arose from a didactic transposition process that simplified and reorganized scholarly knowledge into knowledge to be taught (curriculum) without considering the underlying conceptual structure. The purpose of this study was to identify the form of this gap and to propose an alternative curriculum design that could strengthen students' conceptual understanding. This study used a qualitative approach with a hermeneutic phenomenological design. Data were obtained from the analysis of textbooks, teaching materials, and test results of 35 students at a state university in Aceh, Indonesia. The results showed that the existing curriculum did not emphasize the process of forming the concept of angle pairs meaningfully, but only emphasized visual recognition. As a result, students tend to understand the concept intuitively and experience difficulties when faced with representations that differ from standard illustrations as usually shown in books or lessons. This finding emphasizes the importance of designing knowledge to be taught that allows students' learned knowledge to align with scholarly knowledge. Learning from the didactic transposition process, this research provides theoretical basis and empirical example for the development of a more meaningful and coherent geometry curriculum without neglecting the axiomatic-deductive nature of geometry.

Keywords: *curriculum development, didactic transposition, geometry education.*

1. INTRODUCTION

In mathematics education, the knowledge produced within the scholarly community, such as that developed by mathematicians, does not appear in the classroom in its original form. Instead, it undergoes a transformation process that Chevallard conceptualized as didactic transposition, a sequence of changes that shifts scholarly knowledge into knowledge to be taught, which is then reshaped by teachers into taught knowledge, and eventually becomes learned knowledge in students (Chevallard & Bosch, 2020; Chevallard, 2019). Figure 1 illustrates how this transposition process operates across different institutions. This process is crucial because it shapes the structure of curriculum content, the logical flow of instructional materials, and the ways in which students come to understand mathematical concepts. A well-executed didactic transposition process ensures that the mathematical concepts delivered to students remain accurate (Jamilah et al., 2020). A poorly executed

transposition process frequently leads to misconceptions, shifts in meaning, and a narrowing of students' understanding (Herizal et al., 2025b).

Figure 1. The Process of Didactic Transposition (Chevallard & Bosch, 2020)

Figure 1 illustrates that each stage of the didactic transposition process involves different actors. At the level of scholarly knowledge, the key contributors are mathematicians, universities, and other disciplinary institutions. The next stage involves the noosphere, a group that mediates between scientific knowledge and the educational system. This group decides how disciplinary knowledge is selected, reorganized, and adapted into the knowledge to be taught as it is officially designed by curricula. It includes scholars, educators, curriculum designers, and textbook authors. At the taught knowledge stage, teachers take on the central role, enacting the knowledge to be taught through their instructional practices in the classroom (Bosch & Gascón, 2006).

However, the process of didactic transposition does not always unfold smoothly. In practice, simplifications, omissions, or rearrangements of concepts often occur in ways that obscure the epistemological structure of the content. When such modifications are not supported by adequate pedagogical justification, their impact emerges in the form of student understanding that becomes fragmented, intuitive, and not fully grounded in the intended conceptual relationships. As an example, a research found that the way knowledge was transposed in instruction shaped how students made sense of angle definitions, and this often led them to blur the distinction between an angle as a geometric object and its measure as a numerical value (Herizal et al., 2025b). Although this issue has long been recognized within didactic studies, only a limited number of investigations have examined in detail how these transformations actually occur and what implications they hold for students' conceptual understanding.

To examine this issue more concretely, the present study uses the topic of angle pairs formed when two lines are intersected by a transversal as a case example. Although this topic is typically considered elementary in geometry, its conceptual structure is fairly intricate, involving several definitions and the relationships among geometric objects. The diversity of diagrammatic representations and the interplay among concepts make this topic an appropriate entry point for observing how changes within the didactic transposition process may shape students' understanding, particularly that of prospective mathematics teachers. In Indonesia, prospective mathematics teachers occupy a strategic position because they not only learn geometry but also learn how geometric knowledge is transformed into teachable content. When

the process of didactic transposition is inaccurate or inconsistent, their understanding of a concept can become distorted, and such distortions may later influence their classroom practice. Therefore, identifying how these conceptual gaps emerge holds substantial practical value.

Moreover, research on didactic transposition remains limited within the domain of geometry, particularly for the topic examined in this study. Existing works tend to focus on isolated geometrical ideas, such as quadrilaterals (Akar & Işıksal-Bostan, 2022) or the relationship between central and inscribed angles in a circle (Winarji & Turmudi, 2020). Other studies have instead concentrated on calculus-related themes, including concave–convex functions (Strømskag & Chevallard, 2024), the fundamental theorem of calculus (Topphol, 2023), and the notions of asymptotes and asymptotic behaviour in function graphs (Katalenić et al., 2019). In this context, the present study addressed this gap by providing a detailed analysis of the didactic transposition process as it occurs in university-level mathematics instruction. Specifically, the study examined how scholarly knowledge was transformed into knowledge to be taught and knowledge actually taught, and how this transformation influenced students' understanding. By tracing these processes and identifying the resulting learning obstacles, the findings offer empirically grounded insights that may support the development of better curriculum improvements.

Building on this context, the present study aimed to analyze how scholarly knowledge on the concept of angles formed by a transversal was transformed through the process of didactic transposition, and to identify the types of gaps that emerged between scholarly knowledge and the knowledge understood by students. Using this topic as a case example, the study also sought to offer insights for improving geometry curriculum design so that the transformation of knowledge could better preserve conceptual coherence.

To achieve these aims, the study formulated three research questions: (1) how was scholarly knowledge on angle concepts transformed across the stages of didactic transposition? (2) what conceptual gaps appeared in students' learned knowledge as a result of this transformation? and (3) how the findings from this case study could contribute to the development of a more robust geometry curriculum? Through an analysis of didactic transposition, the study was expected to provide both a theoretical and practical examples for designing a geometry curriculum that not only develops procedural skills but also focuses on conceptual understanding aligned with the geometry scholarly knowledge.

2. METHODOLOGY

2.1. Research Design

This study employed a qualitative approach using a hermeneutic phenomenological design. This design was chosen to analyze how scholarly knowledge was transformed through didactic transposition into knowledge to be taught and taught knowledge and to interpret how pre-service mathematics teachers understood angle pairs formed by a transversal.

2.2. Research Context

The study was situated at a state university in Aceh, Indonesia, involving pre-service mathematics teachers and focusing on plane geometry course, particularly in the topic of angle pairs formed by a transversal, while addressing the gap between scholarly knowledge and students' understanding arising from didactic transposition in textbooks and curricula.

2.3. Participants of the Study

The participants were 35 pre-service mathematics teachers enrolled in plane geometry course at a state university in Aceh, Indonesia. A purposive sampling technique was used to select students who had studied the concept of pairs of angles formed when any two lines were cut by a transversal and its application.

2.4. Instruments

Three instruments were used in this study. First, document analysis of geometry textbook as sources of scholarly knowledge and college textbooks to examine how angle-pair concepts are presented. Second, a geometry concept test with essay items administered to 35 pre-service mathematics teachers to assess their understanding. Third, students' written work was collected to analyze their reasoning and concept construction.

2.5. Data Analysis Techniques

Data were analyzed through document analysis and thematic coding. Textbook data were examined to identify transformations of scholarly knowledge during didactic transposition. Students' test responses were coded to identify reasoning patterns and misconceptions. Findings were interpreted using hermeneutic phenomenology to connect textbook structures with students' learned knowledge.

2.6. Data Validity

Data validity was strengthened through methodological triangulation, including textbook analysis, students' test results, and Focus Group Discussions (FGD), which allowed the findings to be cross-validated across multiple data sources.

2.7. Research Ethics

Ethical considerations have been addressed by ensuring that all participating students provided informed consent, that participation was voluntary, and that anonymity and confidentiality were maintained throughout the data collection and analysis process.

3. RESULT AND DISCUSSION

3.1. The Representation of the Concept of Angles Formed by a Transversal in Scholarly Knowledge

Figure 2 illustrates how the concept of angles formed by a Transversal was introduced in scholarly knowledge. Before reaching this concept, the idea of a transversal is first discussed. A transversal is a line that intersects two or more other lines at two or more distinct points (Lewis, 1968). From these intersections, two groups of angles are formed: the angles located between the two lines, referred to as interior angles, and the angles outside the two lines, known as exterior angles (Alexander & Koeberlein, 2020; Clemens et al., 1990; Lewis, 1968). From this set of angles, several specific angle pairs are then identified, namely corresponding angles, alternate interior angles, alternate exterior angles, same-side interior angles, and same-side exterior angles (Alexander & Koeberlein, 2020; Leonard et al., 2014; Lewis, 1968; Moise, 1990).

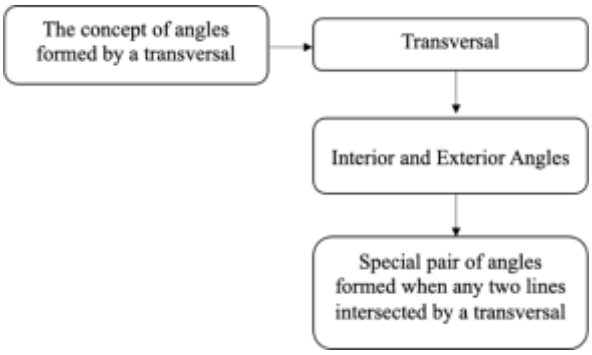

Figure 2. The Construction Process of the Concept of Angles Formed by a Transversal in Scholarly Knowledge

The introduction of special angle pairs formed when two lines are intersected by a transversal should begin with the introduction of the transversal and the interior/exterior angles (Lewis, 1968). This is because the process of identifying and defining these special angle pairs relies on these two components: the transversal and the interior/exterior angles. For example, alternate interior angles are identified by examining two non-adjacent interior angles located on opposite sides of the transversal. If students do not understand which line is the transversal or which angles are interior, it becomes difficult for them to identify these angle pairs. Even if they manage to do so, their understanding tends to be limited to memorizing specific

diagrams. When the illustration changes or becomes more complex, they struggle to correctly identify the angles.

3.2. The Representation of the Concept of Angles Formed by a Transversal in Knowledge to be Taught

The data in this section were obtained from the textbooks used by the lecturers, as confirmed by the lecturers themselves. The analysis of these textbooks showed the sequence of material presentation, which is illustrated in Figure 3. The presentation began with the relationship between two lines, leading to the definition of parallel lines. Subsequently, the theorems that served as conditions for parallelism were presented, viewed in terms of the measures of special angle pairs formed when two lines were intersected by a transversal.

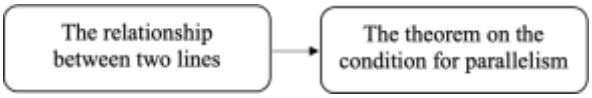

Figure 3. The Sequence of Material Presentation in The Knowledge to be Taught

A problem was identified in the structure and connection between the presented topics. The material was directly presented to the conditions for parallelism, which involved corresponding angles, alternate interior/exterior angles, and same-side interior/exterior angles. However, in the previous tasks, the definitions of these special angle pairs were not explained. This may have hindered students from properly understanding how to identify these angle pairs across different diagram representations. At least two prerequisite tasks were necessary to construct the definitions of these angle pairs: the concept of the transversal and the concept of interior/exterior angles as explained in the scholarly knowledge. These two tasks were essential in defining the special angle pairs. This finding indicated a gap in the material that disrupted the continuity of students' reasoning processes in developing a conceptual understanding of the special angle pairs formed when two lines were intersected by a transversal. This gap was caused by an obstacle called didactical obstacle, where students' difficulties arose from the way of the material was organized and introduced (Brousseau, 1997; Suryadi, 2019).

3.3. The Representation of the Concept of Angles Formed by a Transversal in Taught Knowledge

The data in this section were obtained from the analysis of teaching materials used by lecturer. Document analysis and interviews revealed that no specific teaching materials were prepared by the lecturer. In lectures, the lecturer relied on the textbooks analyzed in the previous section. Nevertheless, even when following the existing textbooks, the process of didactic transposition still occurred. Therefore, the authors examined students' notes to investigate the design of the concept of angles formed by

a transversal as taught by the lecturer in class, complemented by data from lecturer interviews. Several students' notes were reviewed, revealing uniformity in terms of the sequence of topics and the characteristics of the material. Interviews with the lecturer regarding the flow of material presented in class also showed no discrepancies with the students' notes. Consequently, the authors decided to further analyze these notes as a substitute for teaching materials in order to examine the internal didactic transposition process (from knowledge to be taught to taught knowledge).

The analysis of students' notes and lecturer interviews indicated that the pattern of material presentation in class was largely similar to that found in the textbooks. The structure and development sequence followed the same order as shown in Figure 3, with no specific explanations regarding the transversal, interior/exterior angles, or the definitions of special angles formed when two lines are intersected by a transversal. This suggests a tendency for the same potential problems to arise in taught knowledge as those already present in the knowledge to be taught.

3.4. The Students' Learned Knowledge of the Concept of Angles Formed by a Transversal

To examine students' learned knowledge on the topic of the concept of angles formed by a transversal, a test was administered to them. The test results have been reported in our previous article, which showed that students' concept images differed from the formal definitions in scholarly knowledge (Herizal et al., 2025a). The study identified five main concept images: (1) pairs of alternate interior/exterior angles, corresponding angles, and same-side interior/exterior angles are formed when two parallel lines are intersected by a transversal; (2) the measures of corresponding angles must be equal, if they are not, the angles cannot be considered a pair of corresponding angles, and the same applies to alternate interior/exterior and same-side interior angles; (3) alternate exterior angles consist of a pair of angles where one angle is opposite the other and positioned outside the intersection of the lines, which can involve two transversals.

Based on the concept images obtained from the study, students' learned knowledge indicated that pairs of alternate interior/exterior angles, corresponding angles, and same-side interior/exterior angles are formed when two parallel lines are intersected by a transversal. They understood that the measures of corresponding angles, as well as alternate and same-side interior/exterior angles, must be equal to be considered proper pairs. Students also recognized that alternate exterior angles are located opposite each other outside the intersection and can involve two transversals. This form of learned knowledge indicates the existence of epistemological obstacles, specifically difficulties resulting from the initial presentation of the concept in a limited range of contexts (Brousseau, 1997).

In addition to the findings reported in the previous articles, the researchers also provided a problem to demonstrate the similarity of two triangles (see Figure 4). To solve this problem, students needed to identify congruent pairs of special angles in order to apply the Angle-Angle (A-A) theorem.

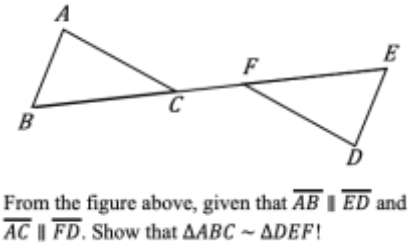

Figure 4. The Problem of Angle Congruence Identification for Triangle Similarity

The test results showed that the majority of students were unable to demonstrate the similarity of the two triangles. Analysis of their responses and interviews revealed that most of their failures were not due to a lack of understanding of the similarity conditions theorem, but rather because they struggled to distinguish between parallel lines and transversals, making it difficult to identify specific congruent angle pairs. This difficulty arose because the configuration in the problem differed from the standard examples found in textbooks or presented in lectures. Furthermore, some students reported determining angle congruence solely through visual observation, without applying the properties of angles formed by parallel lines intersected by a transversal. These issues occurred because their previous coursework did not focus on the process of identifying and defining these special angle pairs. This indicates the presence of didactical learning obstacles.

3.5. Analysis of the Didactic Transposition Process

The analysis of the didactic transposition process on the concept of angles formed by a transversal revealed a noticeable gap between scholarly knowledge and students' actual understanding. Table 1 presents how the concept was introduced or understood in each institution within the didactic transposition process. In this process, the knowledge to be taught was simplified and reorganized from its original scholarly form, focusing mainly on theorems for parallel lines and measurements of special angle pairs, while leaving out explicit explanations of transversals, interior and exterior angles, and how special angle pairs are constructed. This represents an epistemological reduction, where changes in focus, sequence, and depth of content occurred as the material moved from knowledge to be taught to taught knowledge, yet the underlying conceptual weaknesses from the curriculum persisted. This phenomena was also reported in the other didactic transposition studies (Strømskag & Chevallard, 2024; Topphol, 2023).

Table 1. The Concept of Angles Formed by a Transversal in Various Institutions

The Stages of Didactic Transposition	Concept-Introduction and Understanding Approach
Scholarly Knowledge	Introduction of the concept through the transversal and the interior–exterior angles
Knowledge to be Taught	Emphasis on parallelism theorems and special-angle measurements, excluding explicit constructions of transversals, interior/exterior angles, and special angle pairs
Taught Knowledge	Approach similar to that of the knowledge to be taught
Learned Knowledge	- Identifying special angle pairs in standard cases, with difficulty connecting basic concepts to complex configurations - Special angle pairs formed by parallel lines intersected by a transversal - Requirement of equal measures for corresponding and alternate/same-side angles

As a consequence, students' learned knowledge showed conceptual fragmentation. The students could identify special angle pairs and apply definitions in standard examples, but struggled when faced with non-standard or more complex configurations. Many students had difficulty linking basic concepts, such as transversals and interior/exterior angles, to the construction of more complex angle pairs. Some also relied on visual memorization or direct observation, resulting in an understanding that was situational rather than grounded in a coherent, deep comprehension of the mathematical concepts. Although visual representations can support learning (Arcavi, 2003), depending on them too heavily can limit the development of conceptual understanding.

3.6. Insight for Curriculum Improvement

The curriculum is shaped through an agreement among various social agents, including teachers, regarding the learning activities students are expected to undertake. These activities are typically organized around disciplines, concepts, and tasks, and increasingly also encompass skills, competencies, and values (Bosch et al., 2023). All of these elements constitute the knowledge to be taught, according to the theory of didactic transposition (Chevallard & Bosch, 2020). Based on the findings from the analysis of the didactic transposition process, a revision of the geometry learning curriculum is needed, emphasizing the continuity of concepts from foundational ideas to their applications. A key suggestion is to strengthen the basic conceptual foundation, such as transversals and interior/exterior angles, before introducing students to special angle pairs. This can be achieved through gradual introduction and interactive exploration, for instance, using visual activities, manipulatives, or digital simulations, allowing students to identify angle pairs conceptually rather than merely memorizing diagrams.

Furthermore, the curriculum should explicitly emphasize the definitions and properties of special angle pairs, including corresponding angles, alternate interior/exterior angles, and same-side interior/exterior angles, across various diagrammatic representations and configurations. The goal is to enable students to apply these concepts in different contexts and develop a coherent understanding.

Overall, this proposed curriculum revision focuses on the continuity of conceptual logic, active exploration, and strengthening of foundational concepts, making the didactic transposition process more effective and helping students internalize geometric concepts in a meaningful and integrated manner.

4. CONCLUSION

This study revealed a notable gap between the formal scholarly understanding of angles formed by a transversal and the knowledge actually acquired by students. The didactic transposition process, which simplified and restructured scholarly knowledge into classroom teaching materials, often overlooked essential conceptual elements such as the definition of transversals, interior and exterior angles, and how special angle pairs are formed. Consequently, students frequently relied on memorized diagrams and visual cues, which limited their ability to apply concepts in non-standard situations.

The findings highlight the need for a geometry curriculum that prioritizes conceptual continuity, building from foundational ideas to more complex applications. By reinforcing basic concepts, explicitly introducing the properties and definitions of special angle pairs, and incorporating interactive, reflective learning experiences, students can develop a more coherent and flexible understanding. Such an approach ensures that students' learning is not only accurate in standard exercises but also transferable to diverse problem-solving contexts, bridging the gap between what is taught and what is truly understood.

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Integrating a French for Tourism Curriculum Based on SDGs to Enhance Communication Skills of Vocational Students'

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ABSTRACT

This study aims to design a French for Tourism curriculum model based on the Sustainable Development Goals (SDGs), oriented toward improving students' speaking and writing proficiency in vocational higher education. The research is motivated by the gap between students' communication skills and the professional demands of the tourism industry, where French language competence remains below expected standards. The novelty of this study lies in integrating SDGs-driven communicative tasks into vocational French language teaching, a dimension rarely emphasized in previous curriculum models. Employing the Borg and Gall (1983) Research and Development (R&D) model, this study integrates the principles of *Education for Sustainable Development (ESD)* and the *Sustainable Development Goals (SDGs)*, particularly SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth). The curriculum model was developed through stages of needs analysis, design, expert validation, and revision, ensuring its relevance and feasibility for vocational French education.The expected outcome is a validated micro-curriculum framework that enables measurable improvements in students' communicative performance, particularly in task-based speaking and writing activities related to tourism contexts. It is also expected to enhance learners' awareness of sustainability and ethical responsibility, thereby supporting the integration of SDG values into vocational foreign language education. This study contributes both conceptually and practically to developing communicative and sustainability-oriented foreign language education relevant to the evolving needs of the tourism industry.

Keywords: *French for Tourism curriculum, SDGs, speaking and writing proficiency, sustainable tourist, vocational education*

1. INTRODUCTION

The tourism sector has become one of Indonesia's strategic economic pillars, contributing significantly to national development and employment opportunities (UNWTO, 2023). This growth increases the need for vocational graduates who possess strong foreign language communication skills, particularly in major international languages used in tourism contexts such as French. As emphasized by Richards (2021) language learning in vocational settings must prioritize practical, task-based communicative abilities to prepare students for workplace demands. In many vocational higher education institutions in Indonesia, however, French for Tourism instruction still focuses predominantly on general linguistic competence rather than operational communication, limiting students' readiness for authentic tourism interactions.

This condition contributes to the persistent gap between students' communicative performance and the expectations of the tourism industry. According to Rahmawati (2022) vocational students often face challenges in performing spontaneous spoken interactions, fulfilling service-oriented communication tasks, and composing professional written messages. Furthermore, the shift in global tourism toward sustainability and responsible practices requires graduates to possess not only linguistic competence but also intercultural sensitivity, ethical awareness, and sustainability-oriented decision-making (UNESCO, 2021). Yet, these elements remain insufficiently integrated into many existing curriculum models for French for Tourism.

The Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth), provide a strong mandate for improving the relevance and impact of vocational foreign language education (Nations, 2020). Embedding SDG values within a language curriculum encourages learners to engage with issues of sustainability, responsibility, and global citizenship. The principles of Education for Sustainable Development (ESD) emphasize transformative learning, critical reflection, and real-world application all of which can be incorporated into communicative language teaching through scenario-based and problem-oriented tasks (Tilbury, 2020). However, existing literature on French for Tourism indicates a lack of models that systematically integrate SDGs-driven communicative tasks (Munir & Fauzi, 2023).

To address these gaps, this study develops a micro-curriculum model of French for Tourism based on the SDGs, designed to improve vocational students' speaking and writing performance in tourism-related communicative tasks. The curriculum development process adopts the Borg & Gall (1983) Research and Development (R&D) model, which remains widely used in curriculum innovation studies due to its systematic stages of needs analysis, design, validation, and revision (Akker et al., 2020). The novelty of this study lies in embedding sustainability oriented communicative tasks that reflect SDG values into the core structure of vocational French language learning, an aspect that has received little attention in previous research.

The expected outcome of this study is a validated micro-curriculum framework that produces measurable improvements in students' task-based communicative abilities, especially in speaking and writing within tourism contexts. Additionally, the curriculum aims to enhance students' awareness of sustainability and ethical responsibility in professional communication, aligning with the growing global emphasis on responsible tourism (UNWTO, 2022). Conceptually, this study contributes to curriculum development in foreign language education by demonstrating how SDG and ESD principles can be operationalized within communicative language teaching. Practically, it offers a curriculum prototype that can be adopted or adapted by French

for Tourism programs seeking to enhance the relevance and quality of their instructional practices in response to industry needs and global development priorities.

2. METHODOLOGY

This study employed a Research and Development (R&D) design using the Borg and Gall (1983) model, which consists of systematic stages including needs analysis, curriculum design, expert validation, and revision. This methodological approach is widely used in curriculum innovation studies because it provides structured steps that ensure the feasibility, relevance, and practicality of instructional products (Akker et al., 2020). The purpose of adopting this model in the present study is to develop a micro-curriculum for French for Tourism based on the Sustainable Development Goals (SDGs), particularly SDG 4 and SDG 8, and to evaluate its suitability for improving vocational students' speaking and writing skills.

2.1. Research Design

The study followed four primary stages of the Borg & Gall (1983) R&D model that were relevant to the scope of curriculum development targeted in this research. The first stage, needs analysis, aimed to identify students' communicative challenges, industry expectations, and gaps in the existing French for Tourism curriculum. The second stage involved designing a micro-curriculum that integrates SDGs-oriented communicative tasks such as scenario-based role-plays, service interaction simulations, problem-solving tasks, and environmentally responsible tourism discourse. The third stage consisted of expert validation in which curriculum specialists, French language educators, and tourism practitioners evaluated the draft curriculum. The final stage included revisions based on expert feedback to improve content accuracy, task authenticity, SDG integration, and pedagogical feasibility for vocational learning settings.

2.2. Participants of the Study

Participants in this study consisted of vocational learners and expert validators. The student group comprised thirty-five students enrolled in the French for Tourism elective within the Travel Business Program (UPW) at Politeknik Pariwisata NHI Bandung. These students had completed two semesters of French as a foreign language. Purposive sampling was used to select participants who could provide relevant input on communicative needs in tourism contexts. The expert group consisted of three validators: a curriculum and instruction specialist, a French language education expert, and a tourism industry practitioner.

A preliminary diagnostic needs analysis was conducted to assess students' communicative performance in tourism-related speaking and writing tasks. The

diagnostic results are presented in Table 1 and were used to prioritize curriculum targets and task types in the micro-curriculum design.

Table 1. Preliminary Communication Performance of Students (N = 35)

Indicator	Mean	Category
Speaking: spontaneous interaction	2.72	Moderate
Speaking: service-oriented dialogues	2.85	Moderate – Good
Writing: professional message composition	2.68	Moderate
Writing: tourism-related description tasks	2.91	Moderate – Good
Overall communicative performance	2.79	Moderate – Good

The findings indicate that students possess foundational communicative skills but still fall short of industry expectations, particularly in spontaneous spoken responses and professional written messaging. These diagnostic results justify the need for task-based, SDGs-oriented instructional tasks targeted in the micro-curriculum

2.3. Instruments

Data in this study were collected using three primary instruments: a needs analysis questionnaire, expert validation sheets, and semi-structured interviews. The needs analysis questionnaire captured students' self-assessment of speaking and writing challenges, their familiarity with tourism communication tasks, and their awareness of sustainability issues in tourism. The expert validation sheets consisted of rating scales and open-ended comments assessing the curriculum's relevance, clarity, content appropriateness, SDG integration, and task authenticity.

To analyze expert evaluations, this study used Aiken's V to measure the degree of agreement among experts regarding the relevance and clarity of each curriculum component. The formula and detailed explanation of Aiken's V are presented in sub-section 2.4.

The Aiken's V results indicate that most curriculum components achieved acceptable to strong content validity (mean V = 0.77). Based on these findings and experts' qualitative suggestions, the curriculum draft was revised to enhance clarity, task authenticity, and SDG alignment prior to pilot implementation.

2.4. Data Analysis Techniques

The data in this study were analyzed using qualitative and quantitative techniques aligned with the stages of curriculum development. Quantitative analysis was conducted to evaluate expert judgments on the curriculum draft using Aiken's V, a coefficient designed to measure the degree of agreement among experts regarding the relevance, clarity, accuracy, and feasibility of each curriculum component (Aiken, 1985). Aiken's V produces values ranging from 0 to 1, with higher scores indicating stronger content validity.

Aiken's V Formula:

$V = (\sum s) / [n \times (c - 1)]$

where *s* is the score deviation from the lowest score category, *n* is the number of experts, and *c* is the number of response categories. Values above 0.70 are generally interpreted as indicating strong content validity.

Aiken's V values range from 0 to 1, where higher values indicate stronger content validity. In many R&D studies, values of 0.70 or higher are interpreted as acceptable. The evaluations from the three experts were entered into the formula to calculate V for each curriculum component; results are shown in Table 2.

A V-value of 0.67 and above is generally interpreted as acceptable, while values above 0.70 indicate strong item validity (Azwar, 2012). The evaluations from the three experts were entered into the formula to calculate V for each curriculum component, as presented in Table 2. The results were used to revise the micro-curriculum draft to improve its content accuracy, task authenticity, SDG integration, and pedagogical feasibility.

Qualitative analysis was conducted through expert comments and descriptive notes from interviews. These data were coded to identify recurring suggestions related to task clarity, sequencing of learning activities, alignment with SDG 4 and SDG 8, and the suitability of task-based activities for vocational learners. Findings from both quantitative and qualitative analyses informed the final revision of the curriculum model.

Expert Validation Results

Three experts evaluated the draft curriculum based on relevance, clarity, task authenticity, SDG integration, and feasibility for implementation in vocational French for Tourism instruction. The results are presented in Table 2.

Table 2. Expert Validation Result Using Aiken's V

Curriculum Component	Expert 1	Expert 2	Expert 3	Aiken's V	Interpretation
Learning objectives	3	4	4	0.83	Valid
Content relevance	4	3	4	0.83	Valid
Task authenticity	3	3	4	0.75	Valid
SDGs integration	4	4	3	0.75	Valid
Feasibility of implementation	3	4	3	0.67	Acceptable
Overall Mean V	-	-	-	0,77	Valid

The Aiken's V results indicate that most curriculum components achieved acceptable to strong content validity (mean V = 0.77). Based on these findings and

experts' qualitative suggestions, the curriculum draft was revised to enhance clarity, task authenticity, and SDG alignment prior to pilot implementation.

Interpretation of Validation Results

The mean Aiken's V coefficient of 0.77 indicates that the curriculum components demonstrate strong content validity and are suitable for further refinement in the revision stage. All components exceed the minimum acceptable threshold (0.67), showing that the curriculum elements learning objectives, content, tasks, and SDG integration are considered appropriate and relevant by the experts.

These findings ensure that the micro-curriculum model developed in this study is both conceptually sound and practically feasible for French for Tourism learning in vocational programs.

3. RESULT AND DISCUSSION

3.1 Results

The expert validation results indicate that the SDGs-based French for Tourism micro-curriculum model meets the criteria of validity and feasibility for implementation in vocational education settings. As presented in **Table 2**, the expert evaluation covered three main dimensions: content feasibility, linguistic accuracy, and SDGs integration. The average Aiken's V index of 0.83 demonstrates a high level of agreement among experts, indicating that the curriculum prototype is valid, relevant, and aligned with sustainability-oriented learning principles.

In addition, the preliminary needs analysis reveals that students' communicative performance in tourism-related French tasks remains at a moderate level. The mean scores for speaking and writing skills ranged from **2.71 to 2.83** on a 4-point scale. These findings suggest that although students possess basic linguistic competence, they still experience limitations in fluency, accuracy, and contextual appropriateness when performing professional tourism communication tasks in French.

3.2 Discussion

The results confirm that the integration of SDG-oriented communicative tasks into French for Tourism instruction is both pedagogically relevant and feasible. The strong expert agreement supports the view that vocational foreign language education should extend beyond linguistic mastery to include ethical awareness, intercultural sensitivity, and sustainability values. This finding is consistent with Tilbury (2020), who argues that Education for Sustainable Development requires transformative, context-based learning experiences that connect language use with real-world challenges.

Furthermore, the moderate level of students' communicative performance provides strong justification for the development of a task-based micro-curriculum. As

noted by Richards (2021), vocational language learning should prioritize authentic performance tasks that reflect real professional situations. The identified weaknesses in spontaneous speaking, service interaction, and tourism-related writing indicate that traditional grammar-focused instruction is insufficient to meet workplace communication demands.

A key contribution of this study lies in the integration of SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth) within communicative language tasks. Unlike conventional French for Tourism materials that emphasize functional expressions and vocabulary, this curriculum model embeds sustainability-oriented scenarios such as eco-tourism practices, responsible service, and ethical communication in tourism contexts. This approach aligns with UNWTO (2022) recommendations emphasizing the development of tourism professionals with strong global citizenship and sustainability awareness.

Overall, these findings suggest that the SDGs-based micro-curriculum has strong potential to enhance students' communicative competence while simultaneously fostering sustainability awareness in professional tourism settings. The study contributes to the development of a more responsive and future-oriented French for Tourism curriculum that aligns with industry needs and global development priorities.

4. CONCLUSION

This study developed an SDGs-based micro-curriculum model for French for Tourism using Borg & Gall (1983) Research and Development framework. The results indicate that the curriculum prototype meets validity and feasibility standards, as demonstrated by an Aiken's V index of 0.83. Expert evaluations confirmed the relevance of integrating sustainability-oriented communicative tasks into French for Tourism instruction, while preliminary student performance data highlighted the need for improved task-based speaking and writing abilities.

Overall, this curriculum model contributes both conceptually and practically to vocational foreign language education. Conceptually, it demonstrates how SDG and ESD principles can be integrated into communicative language teaching. Practically, it offers a structured and validated curriculum that can enhance students' communicative competence and sustainability awareness in tourism-related contexts. Future research may focus on classroom implementation, student learning outcomes, and adaptation of the model to other foreign languages in vocational settings. Contains conclusions and suggestions.

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Implementation of Grassroots Curriculum Development Model in Indonesia: A Literature Review

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ABSTRACT

This study examines the implementation of grassroots curriculum development model in Indonesia through literature review method. The grassroots model emphasizes a bottom-up approach involving active participation of teachers, students, and local communities in developing curriculum that is responsive to contextual needs. Educational decentralization in Indonesia provides autonomy for teachers to develop curricula relevant to local conditions, which is strengthened through the implementation of Kurikulum Merdeka in 2022. This literature review analyzes journal articles from 2020–2025 period sourced from SINTA, Scopus, and Google Scholar databases, as well as theoretical literature and policy documents using thematic content analysis. Research findings indicate that the grassroots model has strong potential to produce contextual and inclusive curricula that support future-ready education. The implementation of Kurikulum Merdeka demonstrates the strengthening of teachers' roles as primary curriculum developers, although it still faces structural and individual challenges such as limited teacher competencies, inadequate training, insufficient infrastructure, and resistance to change. Success factors supporting implementation include school leadership support, development of professional learning communities, consistent policies, and multi-stakeholder collaboration. This study recommends a holistic approach through sustainable and contextual teacher capacity building, strengthening school leadership support, measured central-local policy harmonization, and development of participatory evaluation mechanisms to optimize the implementation of grassroots-based curriculum development model in Indonesia.

Keywords: *educational decentralization, grassroots model, literature review, merdeka curriculum*

1. INTRODUCTION

Curriculum development remains a central concern in educational reform globally, particularly in contexts marked by socio-cultural and geographical diversity. The traditional top-down approach to curriculum design has increasingly been critiqued for its inability to respond to local contextual needs and diverse learner populations (Marsh & Willis, 2007). In response, the grassroots curriculum development model has emerged as an alternative paradigm emphasizing bottom-up participation, localized adaptation, and stakeholder empowerment (Taba, 1962; Ornstein & Hunkins, 2019).

Indonesia, as an archipelagic nation with remarkable ethnic, linguistic, and cultural diversity, presents a compelling case for examining grassroots curriculum development. Following educational decentralization policies in the late 1990s, Indonesian schools gained increased autonomy in curriculum adaptation (Bjork, 2005).

This autonomy was further strengthened through Kurikulum Merdeka (Independent Curriculum) in 2022, which positions teachers as primary curriculum developers with substantial flexibility in designing learning experiences responsive to local contexts (Kemendikbudristek, 2022).

Despite this policy shift, implementation faces multifaceted challenges including limited teacher competencies in curriculum design, inadequate professional development, infrastructural constraints, and resistance to pedagogical change (Sumartono et al., 2024; Wardana, 2024). Tensions persist between centralized policy mandates and local autonomy, creating implementation gaps requiring systematic investigation (Dewi, 2021; Arif et al., 2022).

This study draws upon three interconnected frameworks: Taba's grassroots curriculum development model, educational decentralization theory, and participatory development approaches. Hilda Taba (1962) pioneered the grassroots approach, consisting of seven sequential steps: diagnosing learner needs, formulating objectives, selecting and organizing content, selecting and organizing learning experiences, and determining evaluation procedures (Portillo et al., 2020). The model prioritizes teacher agency, recognizing educators as curriculum designers rather than mere implementers (Ornstein & Hunkins, 2018), and demands systematic needs assessment based on learners' actual characteristics (Zahara et al., 2025).

Contemporary scholars have expanded Taba's framework to encompass broader stakeholder participation including students, parents, community members, and local knowledge holders (Almadani et al., 2023), aligning with culturally responsive pedagogy emphasizing integration of local wisdom into formal curricula (Fitrianto & Farisi, 2025).

Educational decentralization refers to transferring authority for educational decision-making from central to regional or local levels (Hanushek et al., 2013). Research reveals complex relationships between policy frameworks and actual implementation, with effectiveness depending on adequate local capacity, sufficient resources, clear policy guidance, and supportive accountability systems. In Indonesian contexts, significant variation exists in how schools exercise curriculum autonomy, influenced by school leadership capacity, teacher competence, community engagement, and district-level support (Arif et al., 2022; Juniar & Prasetyo, 2025).

Research on educational decentralization reveals Participatory approaches extend beyond teacher involvement to encompass multiple stakeholder groups with legitimate interests in educational outcomes (Epstein, 2011; Fullan, 2007). Diverse stakeholder perspectives enrich curriculum design by introducing varied forms of knowledge, values, and priorities, while participation fosters ownership and commitment, increasing likelihood of successful implementation (Hargreaves & Fullan,

2015). Effective stakeholder participation requires structured processes, transparent communication, and power-sharing mechanisms (Obi, 2004

While extensive international literature examines grassroots curriculum development and educational decentralization separately, systematic investigation of grassroots model implementation in Indonesian educational contexts remains limited. The recent Kurikulum Merdeka introduction represents a significant policy experiment requiring systematic documentation and analysis. This literature review addresses these gaps by systematically synthesizing empirical and theoretical literature on grassroots curriculum development implementation in Indonesia. Specifically, this study aims to analyze conceptual foundations and characteristics of grassroots curriculum development models in Indonesian contexts, identify implementation patterns, challenges, and success factors across diverse Indonesian educational settings, examine the role of Kurikulum Merdeka policy in strengthening or constraining grassroots approaches, and synthesize evidence-based recommendations for optimizing grassroots curriculum development implementation in Indonesia.

2. METHODOLOGY

2.1. Research Design

This study employed literature review methodology using thematic content analysis to systematically examine grassroots curriculum development models implementation in Indonesia. Literature review represents a rigorous research method involving identifying, evaluating, and synthesizing existing research and theoretical literature to address specific research questions (Snyder, 2019; Paré et al., 2017). The thematic approach organizes findings around key themes and patterns emerging across studies, enabling comprehensive understanding of complex phenomena from multiple perspectives (Braun & Clarke, 2006).

2.2. Literature Search Strategy

The literature search was conducted across three major academic databases: SINTA (Science and Technology Index), Scopus, and Google Scholar. Searches employed combinations of Indonesian and English keywords including “grassroots curriculum development,” “*pengembangan kurikulum* grassroots,” “*Kurikulum Merdeka*,” “curriculum autonomy,” and “decentralized curriculum” using Boolean operators. The temporal scope focused on publications from 2020 to 2025 to capture contemporary developments, particularly the implementation of Kurikulum Merdeka launched in 2022, while foundational theoretical literature predating this period was included to establish conceptual frameworks.

Inclusion criteria comprised: (a) peer-reviewed journal articles or scholarly book chapters; (b) studies explicitly addressing curriculum development or implementation

at school or classroom level in Indonesia; and (c) full-text availability in Indonesian or English. Exclusion criteria included non-academic sources (e.g., news, blogs), duplicate publications, and studies that only mention curriculum superficially without discussing its development or implementation processes.

2.3. Data Extraction and Analysis Techniques

Data extraction was conducted using a structured matrix to record bibliographic information, research aims, context and participants, research design, and key findings related to: (1) conceptualizations of grassroots curriculum development, (2) forms of teacher and community participation, (3) opportunities and challenges within the Kurikulum Merdeka framework, and (4) enabling and constraining factors in school-level implementation. Extracted information from each source was compared and consolidated to allow cross-study analysis and to reduce the risk of misinterpretation of individual studies.

The selected literature was then analyzed using thematic content analysis following Braun and Clarke's (2006) six-phase process, adapted for literature reviews by Vaismoradi et al. (2013): (1) familiarization with the data through systematic reading; (2) generating initial codes identifying concepts, practices, challenges, and factors relevant to grassroots curriculum development; (3) searching for themes by grouping codes into preliminary thematic clusters; (4) reviewing themes through iterative comparison with the original data and across studies; (5) defining and naming themes, including clarifying hierarchical relationships between main themes and subthemes; and (6) producing a synthesis that integrates themes into a coherent narrative addressing the research questions, supported by evidence from multiple sources. This approach positions the study as a qualitative, interpretive synthesis rather than a quantitative meta-analysis.

2.4. Validity and Methodological Limitations

Several strategies were employed to enhance the validity and credibility of the review. First, search procedures, inclusion and exclusion criteria, and analytical steps were reported transparently to allow traceability of the review process. Second, relevance and consistency of included studies were cross-checked by revisiting abstracts and full texts during coding and theme refinement. Third, triangulation was pursued by comparing themes emerging from empirical studies, theoretical works, and policy documents to strengthen the robustness of interpretations.

Despite these efforts, the study has methodological limitations. The review is restricted to publications indexed in selected databases (SINTA, Scopus, and Google Scholar) and to works published in Indonesian and English, which may lead to the omission of relevant studies available in other databases or languages. In addition, the reliance on thematic synthesis without quantitative meta-analysis means that the

findings are context-dependent and not intended for statistical generalization. These limitations should be considered when interpreting the conclusions and implications regarding the implementation of grassroots curriculum development models in Indonesia.

3. RESULT AND DISCUSSION

The thematic analysis revealed five interconnected themes characterizing grassroots curriculum development implementation in Indonesia: (1) conceptualization and potential of grassroots approaches, (2) teacher roles and capacity challenges, (3) structural and systemic barriers, (4) enabling factors and success conditions, and (5) policy-practice dynamics in the Kurikulum Merdeka context.

3.1. Conceptualization and Potential of Grassroots Curriculum Development

The literature conceptualizes grassroots curriculum development as a bottom-up, participatory approach fundamentally reconceptualizing power relationships in educational decision-making. Studies describe grassroots models as inverting traditional hierarchies by positioning teachers, students, and communities as primary curriculum designers rather than passive recipients of centrally mandated programs (Almadani et al., 2023; Oliva, 2017), aligning with Taba's (1962) foundational premise that those closest to the learning process possess essential expertise for designing effective, contextually responsive curricula.

Indonesian scholarship emphasizes relevance of grassroots approaches in the nation's diverse socio-cultural landscape. Indonesia's ethnic, linguistic, and cultural plurality demands curriculum development processes that can integrate local wisdom (kearifan lokal) and community knowledge into formal education. Studies document how grassroots approaches enable this integration through participatory processes valuing multiple knowledge systems (Pertiwi et al., 2025; Fitrianto & Farisi, 2025), serving dual purposes: preserving cultural heritage while making learning more meaningful to students lived experiences.

The reviewed literature identifies multiple potential benefits: contextual relevance with curricula demonstrating stronger alignment with local conditions and learner characteristics; enhanced learner engagement when curricula incorporate familiar cultural references and community connections; and potential for fostering inclusive education by accommodating diverse learner needs through flexible, differentiated curriculum design (Novrizal & Manaf, 2024; Paramita, 2023). However, the literature acknowledges tensions regarding potential conflicts between grassroots flexibility and needs for educational standardization, credential portability, and quality assurance (Dewi, 2021).

3.2. Teacher Roles and Capacity Challenges

A dominant theme concerns teachers' central yet challenging role in grassroots curriculum development. Theoretically, grassroots models position teachers as primary curriculum designers empowered to make professional decisions about curriculum content, pedagogy, and assessment (Taba, 1962; Ornstein & Hunkins, 2019). Kurikulum Merdeka explicitly articulates this vision, describing teachers as "facilitators of independent learning" with substantial autonomy (Kemendikbudristek, 2022).

However, empirical evidence reveals significant gaps between this aspirational vision and teachers' actual capacities. Multiple Indonesian studies identify limited teacher competencies in curriculum development as a major implementation barrier (Wardana, 2024; Efendi et al., 2025; Sumartono et al., 2024). Specific competency gaps include: limited knowledge of curriculum development principles and theoretical frameworks (Purwati & Sukirman, 2024); difficulty conducting systematic learner needs assessments (Zahara et al., 2025); challenges ensuring coherent alignment among learning objectives, instructional content, teaching methods, and assessment strategies (Zendrato & Agatha, 2023); limited capacity to design curricula accommodating diverse learner needs (Nasir et al., 2025); and insufficient digital literacy to integrate educational technology (Tjalla & Sunubi, 2024).

These capacity limitations reflect broader challenges in Indonesia's teacher education and professional development systems. Historical emphasis on teachers as curriculum implementers rather than designers has not adequately prepared educators for autonomous curriculum development roles. Pre-service teacher education programs often provide limited instruction in curriculum development, while in-service professional development opportunities remain insufficient in quality, duration, and accessibility, particularly in rural regions (Firdaus et al., 2023).

3.3. Structural and Systemic Barriers

Beyond individual teacher capacity, the literature identifies multiple structural and systemic barriers operating at organizational, institutional, and policy levels. Resource constraints represent fundamental challenges, particularly in economically disadvantaged regions, with insufficient instructional materials, limited technological infrastructure, inadequate physical facilities, and lack of financial resources (Wardana, 2024; Sumartono et al., 2024). Rural and remote schools face especially acute resource limitations, creating significant equity concerns (Tjalla 7 Sunubi., 2024).

Professional development systems emerge as inadequately designed to support grassroots curriculum implementation, with systemic weaknesses including episodic rather than sustained professional learning opportunities, generic training failing to address context-specific challenges, insufficient follow-up support and mentoring,

limited opportunities for collaborative learning, and inadequate time allocated for curriculum development work (Firdaus et al., 2023; Purwati & Sukirman, 2024).

Administrative and leadership capacity significantly influences grassroots implementation at school level. School principals and leadership teams play critical roles in creating enabling conditions, yet studies indicate substantial variation in Indonesian school leadership capacity, with many principals lacking training in instructional leadership or curriculum management (Juniar & Prasetyo, 2025). Policy ambiguity and inconsistency create implementation challenges, with teachers reporting uncertainty about boundaries of autonomy and quality standards (Zendrato & Agatha, 2023; Wardana, 2024). Additionally, central-local government coordination presents ongoing challenges, with insufficient coordination mechanisms between administrative levels resulting in conflicting guidance, inefficient resource allocation, and weak accountability systems (Desimaria & Rahayu, 2022; Fatimah et al., 2024).

Administrative and leadership capacity significantly influences grassroots implementation at school level. School principals and leadership teams play critical roles in creating enabling conditions: establishing shared vision and clear expectations for curriculum work, providing resources and time for teachers to engage in curriculum development, modeling and supporting pedagogical innovation, facilitating collaborative structures and professional learning communities, and buffering teachers from external pressures while maintaining accountability (Gunnulfsen & Abrahamsen, 2024; Salawana, 2019). However, studies indicate substantial variation in Indonesian school leadership capacity, with many principals lacking training in instructional leadership or curriculum management (Juniar & Prasetyo, 2025). Furthermore, competing administrative demands and bureaucratic requirements often consume principals' time and attention, limiting their capacity to provide instructional leadership.

3.4 Enabling Factors and Success Conditions

Despite substantial challenges, the literature identifies multiple factors enabling successful grassroots curriculum implementation. Strong instructional leadership emerges as perhaps the most critical success factor, with effective schools featuring principals and leadership teams who articulate clear vision, provide tangible support, actively participate in curriculum development processes, and create safe environments for experimentation (Gunnulfsen & Abrahamsen, 2024; Tusianah et a., 2019).

Professional learning communities (PLCs) constitute powerful structures for supporting teacher learning and curriculum development, characterized by regular structured collaboration time, shared responsibility for student learning outcomes, collective examination of student work, collaborative curriculum design, and reflective inquiry (DuFour et al., 2016; Vescio et al., 2008). Indonesian studies document how

PLCs reduce teacher isolation, enable knowledge sharing, build collective efficacy, and create spaces for innovation (Wardana, 2024; Rahmadani et al., 2025).

Stakeholder participation and community engagement enhance curriculum relevance and implementation support. Schools successfully implementing grassroots approaches demonstrate active engagement with parents, community members, local organizations, and students themselves as curriculum co-designers (Epstein, 2011). Contextually responsive professional development proves more effective than generic training, featuring sustained engagement, embedded learning opportunities, differentiation based on context-specific needs, collaborative structures, and ongoing coaching support (Darling-Hammond et al., 2017). Supportive policy environments balance flexibility with structure through clear articulation of curriculum aims, explicit guidance on scope of local autonomy, quality standards focusing on learning outcomes, and coherent alignment across policy levels (OECD, 2024; Rahmadani et al., 2025).

3.5. Policy-Practice Dynamics in Kurikulum Merdeka Implementation

The implementation of Kurikulum Merdeka since 2022 represents Indonesia's most explicit policy effort to institutionalize grassroots curriculum development at scale. Analysis reveals both promising developments and persistent challenges. Positive developments include increased teacher awareness and engagement with curriculum autonomy, with growing recognition of their roles as curriculum developers and appreciation for flexibility to adapt teaching to student needs (Zendrato & Agatha, 2023; Purwati & Sukirman, 2024). Kurikulum Merdeka's staged implementation provides flexibility for capacity development and reduces pressure for premature implementation (Kemendikbudristek, 2022).

However, significant implementation challenges persist. The policy's flexibility creates interpretation difficulties, with teachers expressing confusion about boundaries of autonomy and quality expectations (Wardana, 2024). Systemic capacity constraints limit schools' ability to fully utilize granted autonomy, particularly in resource-limited settings (Sumartono et al., 2024). Assessment and evaluation systems have not fully evolved to align with Kurikulum Merdeka's competency-based approach, creating tensions between innovative curriculum and traditional assessment (Nasir et al., 2025).

Policy sustainability depends on ongoing commitment to capacity building and resource provision, maintenance of policy coherence, development of robust evaluation systems, and genuine responsiveness to implementation feedback. Research indicates that substantive change typically requires 5-7 years of sustained implementation, demanding political will and systemic commitment beyond initial reform enthusiasm (Fullan, 2007).

3.6. Synthesis and Theoretical Implications

Synthesizing findings reveals several overarching insights. First, grassroots curriculum development represents not merely a technical design process but fundamental reconceptualization of professional roles, power relationships, and knowledge valuation in education systems. Second, the relationship between policy autonomy and actual practice proves complex and mediated by multiple factors. Simply granting autonomy through policy does not automatically translate into grassroots curriculum development. Third, grassroots curriculum development implementation presents inherent tensions requiring ongoing negotiation: autonomy versus standardization, innovation versus equity, local responsiveness versus systemic coherence, and flexibility versus accountability. Fourth, sustainable grassroots implementation demands holistic, systemic approaches addressing multiple dimensions simultaneously: individual teacher capacity, organizational structures, policy frameworks, resource allocation, and community engagement.

These findings resonate with international research on curriculum reform and educational change. Fullan's (2007) work emphasizes that successful reform requires attending to meaning, capacity, and commitment—all evident in factors identified in this review. Similarly, Hargreaves and Fullan's (2015) emphasis on professional capital aligns with findings regarding teacher capacity, PLCs, and professional autonomy. From theoretical perspective, the Indonesian experience illuminates tensions in decentralized educational governance, with Weiler's (1990) framework helping explain both the appeal of grassroots approaches and implementation challenges.

4. CONCLUSION

This literature review provides comprehensive analysis of grassroots curriculum development model implementation in Indonesia, with particular attention to the Kurikulum Merdeka context.

There are four principal findings in this research. First, grassroots curriculum development models demonstrate strong potential for producing contextual, inclusive, and future-ready curricula aligned with Indonesia's diverse socio-cultural landscape and 21st century learning imperatives. The bottom-up approach emphasizing teacher agency, stakeholder participation, and local knowledge integration addresses limitations of traditional top-down models and aligns with decentralization policy frameworks. When effectively implemented, grassroots approaches enhance curriculum relevance, learner engagement, cultural preservation, and development of higher-order competencies.

Second, implementation of grassroots approaches faces multifaceted challenges operating at individual, organizational, and systemic levels. Teacher capacity limitations, including insufficient curriculum development knowledge,

inadequate professional preparation, and resistance to pedagogical change, constitute primary barriers. These individual challenges are compounded by structural constraints: resource inadequacies, particularly in disadvantaged regions; insufficient professional development systems; variable school leadership capacity; policy ambiguities and frequent changes; and coordination gaps in decentralized governance structures. These challenges risk creating inequitable implementation where well-resourced contexts thrive while under-resourced settings struggle.

Third, successful implementation depends on interconnected enabling factors rather than single interventions. Strong instructional leadership focusing specifically on curriculum work, professional learning communities providing collaborative structures and peer support, meaningful stakeholder participation building shared ownership, contextually responsive professional development addressing specific needs, and supportive policy environments balancing autonomy with guidance consistently characterize settings demonstrating effective grassroots implementation. These factors operate synergistically, with strength in one dimension compensating somewhat for limitations in others, while weakness across multiple dimensions creates formidable obstacles.

Fourth, Kurikulum Merdeka policy represents important progress in institutionalizing grassroots curriculum development, explicitly positioning teachers as primary curriculum developers and providing substantial implementation flexibility. Early implementation evidence shows increased teacher awareness of curriculum autonomy and appreciation for pedagogical flexibility. However, realization of policy intentions remains uneven, mediated by persistent capacity constraints, resource limitations, interpretation ambiguities, and systemic inertia. The policy's success will ultimately depend on sustained commitment to capacity building, resource provision, coherent implementation support, and responsive policy adaptation based on implementation evidence.

This review contributes to curriculum development scholarship by illuminating how grassroots models operate within diverse, decentralized educational systems characterized by significant contextual variation and capacity constraints. While existing literature primarily documents grassroots curriculum development in relatively homogeneous or well-resourced contexts, the Indonesian case reveals tensions and enabling conditions particularly relevant for large-scale implementation in complex, diverse systems.

Based on synthesized evidence, this review proposes several practical recommendations for strengthening grassroots curriculum development implementation: Comprehensive, sustained teacher capacity building; Strategic leadership development; Resource equity and infrastructure development; Coherent,

enabling policy frameworks; Participatory evaluation and learning systems; multi-stakeholder collaboration.

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Integrating Geopark into School-Level Curriculum in Indonesia: A Case Study at SMPN 1 Kejajar, Central Java

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ABSTRACT

Indonesia's unique position at the convergence of three major continental plates has resulted in exceptional geological diversity and high geological value. However, this location also exposes the country to significant geological hazards, including earthquakes, volcanic eruptions, tsunamis, and landslides. To maximize the positive impacts of this geological richness and minimize its potential risks, proper management, preservation, and utilization within Geopark areas are essential to support sustainability through active participation in four main elements: conservation, education, sustainable economy, and community culture. The purpose of this study is to describe how SMPN 1 Kejajar integrates Geopark into its school-level curriculum. This research employs a qualitative approach with a case study design. Data were collected through observation, interviews, and documentation. The findings show that SMPN 1 Kejajar selected several key elements as references in integrating Geopark into the school-level curriculum. The selection of these elements is based on the school's context, specific needs, and the characteristics of its students. Geopark elements are integrated into various aspects of the school-level curriculum, including: the characteristics of the school; the school's vision, mission, and goals; the organization of learning; as well as the planning of learning.

Keywords: *biodiversity, cultural diversity, geopark, school-level curriculum.*

1. INTRODUCTION

The geological condition of Indonesia, which is located at the convergence of three tectonic plates, results in a rich and valuable geological diversity. This geodiversity contains significant geoheritage linked to biodiversity and cultural diversity. It can also be utilized through the concept of sustainable geopark development, especially to support tourism destinations (Peraturan Presiden Republik Indonesia Nomor 9 Tahun 2019).

A geopark is a single or combined geographical area that contains geological diversity, biodiversity, and cultural diversity. It is managed for nature conservation, education, and sustainable local economic development, with active participation from communities and local governments. Through this approach, geoparks help promote public understanding and awareness of the Earth and the surrounding environment (Peraturan Presiden Republik Indonesia Nomor 9 Tahun 2019; Hutabarat, 2023; Insani, et al., 2023; UNESCO.org, 2025). According to Badan Geologi Kementerian Energi dan Sumber Daya Mineral (2025), Indonesia currently has 12 UNESCO Global Geopark, including Mount Batur Geopark, Belitong Geopark, Ciletuh Geopark, Gunung Sewu

Geopark, Rinjani Lombok Geopark, Toba Caldera Geopark, Raja Ampat Geopark, Maros-Pangkep Geopark, Merangin Geopark, Ijen Geopark, Kebumen Geopark, and Meratus Geopark. In addition, several national geopark are being prepared to become UNESCO Global Geopark, including the Dieng National Geopark, which was recently designated through Surat Keputusan Menteri Energi dan Sumber Daya Mineral No.172.K/GL.01/MEM.G/2025 on 7 May 2025.

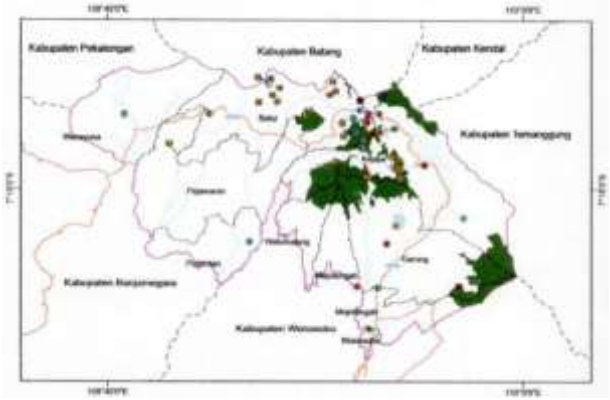

Figure 1. Map of the Delineated Area of Dieng National Geopark

The Dieng National Geopark covers a total area of 319.36 km², spanning the administrative regions of Wonosobo Regency, specifically Kejajar, Garung, Mojotengah, Watumalang, and Wonosobo Districts; and Banjarnegara Regency, including Batur, Pejawaran, Wanayasa, and Pagentan Districts. The geopark consists of 23 geosites, 8 biosites, 9 cultural sites, and 6 additional key destinations that support sustainable development (Keputusan Menteri Energi dan Sumber Daya Mineral, 2025).

Based on Peraturan Menteri Perencanaan Pembangunan Nasional/Kepala Badan Perencanaan Pembangunan Nasional Nomor 15 Tahun 2020, geopark areas, including the Dieng National Geopark, contribute to achieving the Sustainable Development Goals (SDGs), particularly in relation to quality education. The Dieng National Geopark helps raise public awareness of geological heritage and its connection to natural and cultural heritage. Geopark also encourages communities to adopt sustainable development practices, promote sustainable lifestyles, and appreciate diversity and peace.

The development of geopark, especially within the education pillar, needs to be aligned with Indonesia's national education system. Undang-undang Republik Indonesia Nomor 20 Tahun 2003 mandates that curriculum at all levels and types of education must be developed using diversification principles, based on the educational institution, regional potential, and student characteristics. Diversified curriculum development allows educational institutions to adjust their programs to local conditions and unique regional potentials. Curriculum diversification is implemented through the development of school-level curriculum (Kurikulum Satuan Pendidikan). The main references for developing this curriculum include: (1) the national curriculum framework

and structure, and (2) the school's vision, mission, and characteristics. The school-level curriculum should be a dynamic document that is continuously updated, used as a daily reference, reflected upon, and revised based on evaluation and the school's needs. According to Badan Standar, Kurikulum, dan Asesmen Pendidikan (2025), four key components must be included in the school-level curriculum: the characteristics of the school; the school's vision, mission, and goals; the organization of learning; as well as the planning of learning.

The development of the school-level curriculum aims to help school leaders design a diversified curriculum based on the identified potential and characteristics of the region, the school, and the students. This diversification is expected to strengthen the school's unique identity and support the achievement of its vision, mission, and goals. However, many schools still experience challenges in identifying local potential and uniqueness, and integrating them into their school-level curriculum. Therefore, a curriculum model that integrates local natural and cultural resources, particularly in the Dieng National Geopark area, is needed as a reference for other schools with similar regional contexts. This study aims to describe how SMPN 1 Kejajar, located within the Dieng National Geopark, integrates geopark elements into its school-level curriculum.

2. METHODOLOGY

2.1. Research Design

This study employs a qualitative approach using a case study design. According to Rahardjo (2017), a case study is a series of scientific activities carried out intensively and in depth on a program, event, or activity, whether related to individuals, communities, institutions, or organizations, to obtain a thorough understanding of the phenomenon. In this study, the case study approach is used to explore how an educational institution integrates geopark elements into its school-level curriculum.

2.2. Participants of the Study

The participants in this study were the curriculum developer team at SMPN 1 Kejajar, Wonosobo, Central Java. Participants were selected through purposive sampling to meet the research objectives. A total of 13 curriculum team members were involved: 1 school supervisor, 1 principal, 1 vice principal, and 10 teachers. SMPN 1 Kejajar was selected because it has implemented the Merdeka Curriculum, is located within the Dieng National Geopark, and was recommended by the Regional Office of Education (*Dinas Pendidikan*).

2.3. Instruments

Data were collected through observation, interviews, and documentation. The instruments used in this study included the researcher, observation and interview

guidelines (based on the school-level curriculum development guide), and a review instrument for the school-level curriculum. Observations and interviews were conducted during the researcher's visit to SMPN 1 Kejajar, while the document review took place through in-depth analysis using focus group discussions held both offline and online.

2.4. Data Analysis Techniques

The data analysis techniques used in this study include data reduction, data display, and conclusion drawing. Data reduction was conducted by summarizing the collected data into concepts, categories, or themes. Data display involved organizing information systematically in the form of narrative text, charts, matrix, or diagrams for ease of interpretation. Conclusion drawing was carried out by comparing the presented data, interpreting their meaning, and identifying key findings throughout the research process (Sugiyono, 2017; Rijali, 2018; Akbari & Seituni, 2021, Septiana, et al., 2024).

3. RESULT AND DISCUSSION

SMPN 1 Kejajar is located on Jalan Dieng Km 17 in Kejajar Village, Kejajar Subdistrict, and lies along the main road to the Dieng area, at latitude -7.2532° and longitude 109.9554°. The school has developed its school-level curriculum under the title "Geoeducation." Table 3.1 presents the geopark elements integrated into the Geoeducation Curriculum of SMPN 1 Kejajar.

Table 1. Geopark Elements in the Geoeducation Curriculum of SMPN 1 Kejajar

Element	Competency Focus
Knowledge	Analyzing geological phenomena and their relationship to community life in the geopark area
Conservation	Applying conservation efforts to geosites in the geopark area
Sustainable Economy	Analyzing the economic potential based on natural and cultural resources in the geopark area
Community Culture	Analyzing the importance of historical (human, space, and time) and cultural elements in community development within the geopark area

These four geopark elements are embedded in the four components of the Geoeducation Curriculum at SMPN 1 Kejajar.

The Characteristics of the School

In this section, SMPN 1 Kejajar describes its geographical setting, local biodiversity, and cultural traditions that are still preserved by the community. All these potentials are used in curriculum development and classroom learning. The following narratives were obtained from interviews and documentation:

"Located in the Dieng valley area, SMPN 1 Kejajar has a cool climate and is surrounded by hills. The fresh air supports students' concentration and overall well-being. The beautiful mountain landscape can be utilized as a natural laboratory for subjects such as Social Studies-Geography, Biology, and Cultural Arts. These natural conditions can be further developed through educational tourism programs or outdoor learning activities such as hiking. This natural wealth needs to be utilized to support learning and curriculum development that emphasizes the use of natural resources in the Dieng National Geopark area."

"In addition to its geological diversity, the area around SMPN 1 Kejajar has endemic highland flora and fauna such as Dieng chilies, carica, tamarillo, and Wonosobo sheep. These resources can serve as practical learning materials for Biology and Agriculture. The school has access to clean water and fertile soil for gardening practice. It is also close to local farms, such as potato, carrot, cabbage, and other vegetable plantations. SMPN 1 Kejajar collaborates with local carrot farmers and washing facilities as partners for cocurricular activities on carrot processing, which supports the agriculture-based local content in Wonosobo."

"Various traditions and cultural values are still strongly preserved in the local community. One of the most prominent traditions is the "Ruwatan Rambut Gimbal" ceremony. This tradition can be integrated into contextual learning materials. In addition, community values such as mutual cooperation (gotong-royong) become strong social capital in supporting school programs, such as community service activities and school–parent partnerships. The school can also involve cultural leaders (tokoh adat) as keynote speakers in cocurricular and extracurricular programs."

The School's Vision, Mission, and Goals

According to Badan Standar, Kurikulum, dan Asesmen Pendidikan (2025), the vision represents the long-term aspirations of the school community. The mission explains how the school achieves this vision, while the goals describe the expected outcomes within a certain timeframe based on the school's unique characteristics.

In line with that definition, SMPN 1 Kejajar has developed its vision, mission, and goals integrated with the geopark concept. The school's vision is: "To develop students with noble character, global awareness, academic excellence, digital literacy, and environmental responsibility." The "global awareness" and "environmental responsibility" vision are related to geopark and are elaborated in the mission and goals shown in Table 2.

Table 2. The Vision, Mission, and Goals of SMPN 1 Kejajar Related to Geopark

Vision Global Awareness	Vision - Environmental Responsibility
Mission: ● To develop students' mindsets so they are able to understand and respond to international issues, especially climate change. ● To foster students' critical thinking skills in addressing the challenges of global climate change.	**Mission:** ● To encourage students' active participation in programs that promote a safe, healthy, orderly, and beautiful school environment. ● To cultivate students' awareness of the geological, biological, and cultural diversity within the school environment. ● To support students' active involvement in efforts to conserve geological, biological, and cultural diversity in the school area.
Goals: ● Students develop the ability to identify the causes and global impacts of climate change by the end of the first semester. ● Students develop the ability to analyze the effects of climate change on their local or regional environment by the end of the first semester. ● Students develop the ability to propose solutions for addressing climate change by the end of the first semester.	**Goals:** ● Students develop awareness of geological, biological, and cultural diversity by the end of the academic year. ● Students develop mindsets that support the prevention of environmental degradation in their surroundings by the end of the academic year. ● Students care for cultural preservation by the end of the academic year. ● Students care for the protection of water sources within the school environment by the end of the academic year.

The Organization of Learning

SMPN 1 Kejajar organizes learning activities into intracurricular, cocurricular, and extracurricular programs. In the intracurricular program, subjects related to geopark include Social Studies (IPS), Natural Science (IPA), Craft (Prakarya), and Pancasila Education. In the Social Studies subject, the geopark-related topic is spatial connectivity in the use and conservation of natural resources. In this topic, students learn to understand the geographical diversity of the Dieng Geopark area, analyze spatial connectivity with the Dieng Geopark, identify how natural resources are utilized in the area, process information, and propose solutions for environmental conservation efforts in the Dieng Geopark. One of the products students may create in this learning process is a poster encouraging environmental preservation in the geopark area.

The geopark-related topic in the Natural Sciences subject is the interaction between living organisms and their environment. Students analyze these interactions and then design strategies to prevent and address climate change. They plan concrete and solution-oriented actions, then communicate their ideas through engaging

campaign media. Students are also encouraged to critically evaluate the steps that can be taken to protect the environment and to consider alternative actions that are appropriate and effective for the Dieng Geopark area.

In the Craft subject, the relevant topic covers the characteristics of products, materials, tools, processing techniques, packaging, and presentation of food and non-food processed products based on local environmental potential. In this lesson, students process locally grown vegetables, particularly carrots, into various food products such as wet and dry candied carrots and carrot drink powder. Beyond food processing, students also analyze appropriate packaging for the products they create.

In the Pancasila Education subject, the relevant topic focuses on the importance of preserving traditions, local wisdom, and culture as part of national identity. In this lesson, students watch a video featuring the culture, traditions, and local wisdom found in the Dieng Geopark. Working in groups, they identify information from the video and transform it into both digital and non-digital clippings. These clippings are then presented and displayed as part of a classroom wall magazine.

The efforts made by SMPN 1 Kejajar to integrate the Dieng Geopark into the intracurricular program are in line with other studies conducted in the Toba Caldera Geopark area. According to Siregar et al. (2025), several schools in the Toba Caldera Geopark have started to integrate learning content on geological formation, caldera lakes, and local wisdom into subjects such as Science, Geography, and local content courses. Teachers are trained to develop learning media based on geosites, such as student worksheets, documentary videos, and thematic maps, so that learning becomes more engaging and relevant to the surrounding environment. Moreover, the scenic beauty of the Toba Caldera combined with the rich Batak culture has made Lake Toba one of the country's main tourist destinations and part of the list of the ten "New Bali" sites (Manurung & Sinabariba, 2021).

In the **cocurricular program**, SMPN 1 Kejajar organizes *dimensi profil lulusan*, themes, and the type of cocurricular by incorporating geopark-related content that reflects the local context, as presented in Table 3.

Table 3. The Organization of Cocurricular Related to Geopark at SMPN 1 Kejajar

Outcome Profile Dimension	**Theme**	**Type of Cocurricular**	**Time Allocation**
Critical Thinking and Collaboration	Caring for the Environment of the Dieng Geopark Area-Protect, Maintain, Preserve (*Jaga*, *Rawat*, *Lestarikan* - *JAWARA*)	Collaborative learning across disciplines	123 learning hours (block system) from November to December 2025

Outcome Profile Dimension	Theme	Type of Cocurricular	Time Allocation
Creativity and Collaboration	Processing Local Vegetables of the Dieng Geopark	Other relevant activities	123 learning hours (block system) from May to June 2026

SMPN 1 Kejajar implements the theme "Caring for the Environment of the Dieng Geopark Area – Protect, Maintain, Preserve (*Jaga*, *Rawat*, *Lestarikan* - *JAWARA*)" in Grades VII, VIII, and IX. In Grade VII, students work together to identify geological, biological, and cultural diversity as well as initial conservation efforts in the Dieng Geopark through discussions and presentations. In Grade VIII, students collaborate to identify disaster threats and risks, along with conservation efforts in the Dieng Geopark, through discussions and the production of documentary videos. In Grade IX, students work together to identify the concept of sustainable development in the Dieng Geopark by producing educational media and digital conservation projects.

The theme "Processing Local Vegetables of the Dieng Geopark" is also implemented in Grades VII, VIII, and IX. In Grade VII, students collaborate to identify information about carrot commodities in the Dieng Geopark area and create simple carrot-based food products. In Grade VIII, students work together to prepare more advanced carrot-based products and design both the packaging and labeling for specialty carrot products from the Dieng Geopark. In Grade IX, students innovate by creating both food and non-food carrot-based products and attempt to market them, followed by the preparation of a final report.

In the extracurricular program, SMPN 1 Kejajar does not explicitly integrate geopark content into its extracurricular programs, such as scouting, sports, arts, and academic development (olympiads). However, the school offers self-development and school culture programs that broaden students' knowledge and awareness of the Geopark. These include literacy activities, such as promoting reading habits and developing a reading culture through fiction and non-fiction books, such as general knowledge books, encyclopedias, agriculture, and geology.

Aligned with the school culture at SMPN 1 Kejajar, geopark literacy practices implemented in other geopark areas across Indonesia may also serve as inspiration for schools. In the Ciletuh Geopark, a Geopark Corner was established in 2017 at SDN Tegalcaringin, Sukabumi. Its attractions include poetry collections related to the Ciletuh Geopark, handicrafts made by students, miniatures of several geosites, curriculum books, and geopark teaching aids and games (Ibrahim & Adiputra, 2023). In the Karangsambung-Karangbolong Geopark in Kebumen, the local Archives and Library Office has developed geopark literacy through a Geopark Corner that provides books about the geopark, information about geopark locations across Kebumen and nearby

areas, historical information and maps of each geopark destination, as well as exhibitions and posters on geology and local culture (Sundariyati & Zain, 2024).

The Planning of Learning

SMPN 1 Kejajar develops learning plans at the school level (in the form of Learning Objective Sequences/Alur Tujuan Pembelajaran-ATP) and at the class level (in the form of lesson plans). The ATP and lesson plan for intracurricular presented in this section are for the Social Studies subject, while the cocurricular lesson plan refers to the JAWARA theme.

In the Social Studies subject, the selected learning objective is to analyze spatial connectivity in relation to the use and conservation of natural resources. This learning objective is achieved over four meetings. In the first meeting, students are guided to understand the geographical diversity of the Dieng Geopark and the concept of spatial connectivity. In the second meeting, students identify how natural resources are utilized and analyze the impacts of spatial connectivity. In the third meeting, students develop solutions for conserving natural resources. In the fourth meeting, students communicate their conservation solutions and reflect on them.

In the *JAWARA* cocurricular theme, activities focus on developing students' ability to recognize and identify the geological, biological, and sociocultural diversity of the Dieng Geopark, as well as fostering curiosity and early awareness of environmental preservation. Collaboration between the Natural Sciences subject and Social Studies subject help students deepen their understanding of ecosystems, biodiversity, and pollution issues. Moreover, students are encouraged to analyze the impacts of human activities on the environment, local wisdom, nature conservation, and geological disaster mitigation. Other relevant subjects include Indonesian Language, particularly when students create slogans and conduct interviews. The *dimensi profil lulusan* emphasized in this theme are critical thinking and collaboration. The sequences of cocurricular activities include: 1) triggering discussion & creating the Dieng Geopark mind map; 2) designing the "Dieng footprint album"; 3) creating flora/fauna diary & simple geological map of the Dieng Geopark; 4) collecting evidence of cultural heritage & changes in the Dieng Geopark; 5) interviewing key community figures & creating a mini geopark campaign; 6) presenting the idea "why is Dieng Geopark unique?"; and 7) "Dieng and I" reflection.

4. CONCLUSION

The Geoeducation Curriculum of SMPN 1 Kejajar integrates geopark elements, including knowledge, conservation, sustainable economy, and community culture, into the characteristics of the school; the school's vision, mission, and goals; the organization of learning; as well as the planning of learning. This integration represents a good

practice model that can be adapted by other schools across Indonesia, especially those located within Geopark areas, as a form of curriculum diversification aligned with local contexts and needs.

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The Impact of Extended Reality Environmental Learning on Students' Eco-Literacy: A Systematic Review

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ABSTRACT

Current environmental challenges such as climate change, pollution, and loss of biodiversity demonstrate the need for an educational approach that fosters deep understanding and sustainable behavior. Schools play a central role in developing ecological literacy, awareness, and environmental responsibility in students. This study aims to explore how the use of Extended Reality (XR) affects students' knowledge, attitudes, and behavior towards the environment, as well as to identify the types of Extended Reality technology that have been applied in environmental literacy education. The research method used was a Systematic Literature Review following PRISMA 2020 guidelines, analyzing 24 empirical articles published between 2020 and 2025 from Scopus and Google Scholar databases on the application of XR-based environmental learning at various educational levels. The results show that the integration of XR, particularly Virtual Reality (VR), can improve students' understanding of environmental concepts, empathy, and motivation to behave in an environmentally friendly manner. Augmented Reality (AR) is effective in supporting conceptual learning and increasing learning engagement, while 360° videos and serious games provide an interactive learning experience that is easily accessible to young learners. However, Mixed Reality (MR) remains under-explored, and most studies have not examined the long-term behavioral impact. Overall, XR-based learning not only improves cognitive and affective aspects but also encourages emotional connection and behavioral change towards nature. From the research results, it can be concluded that Extended Reality is a promising learning medium to strengthen students' environmental literacy and awareness. Further research is recommended to investigate the long-term impact of XR on real environmental actions and its application in the Indonesian educational context to make it more inclusive and sustainable.

Keywords: *Augmented Reality, Eco-Literacy, Environmental Education, Extended Reality, Virtual Reality*

1. INTRODUCTION

Environmental issues, such as global warming and biodiversity loss globally (Shcheblyakov et al., 2019), and deforestation and rising sea levels nationally in Indonesia (Fatimah et al, 2024), present serious threats to human welfare. These large-scale impacts often stem from accumulated daily human behaviors. A core challenge in addressing this crisis is widespread public indifference, largely because environmental education is often delivered in an informative, non-contextual manner, failing to convey the real-world urgency of these issues. Environmental education, therefore, tends to be viewed as a complementary topic rather than a crucial subject.

To bridge this gap and promote meaningful environmental engagement, a new, impactful pedagogical approach is needed. Extended Reality (XR), an umbrella term encompassing Virtual Reality (VR) and Augmented Reality (AR) (Rauschnabel et al., 2022), offers a solution. XR allows students to move beyond passively reading about environmental damage by enabling them to explore it in realistic, interactive, and emotional virtual or augmented scenarios. VR immerses users in fully simulated spaces, while AR overlays digital elements onto the real world. This technology is uniquely aligned with key educational principles. By providing direct, sensory-rich, and interactive experiences, XR supports Experiential Learning (Kolb), where knowledge is gained through direct action; Contextual Learning, by placing concepts in a real-life framework; and Constructivism (Piaget and Vygotsky), where students actively build understanding through interaction (Do, Do & Nguyen, 2023). Furthermore, the Multisensory Learning approach engaging sight, hearing, and movement creates a richer, deeper, and more lasting impact on students' memories (Chandramouli, Zafar & Williams, 2025).

This process contributes directly to the development of Ecoliteracy, defined as the awareness and ability to understand ecological systems and act sustainably (Desmarais, 2024). Through its immersive nature, XR has the potential to influence the full scope of this literacy: the cognitive (understanding), the affective (concern), and the behavioral (pro - environmental actions).

Thus, this study seeks to investigate the transformative potential of XR in environmental education. This study addresses the following questions: 1) How does the use of Extended Reality (XR) affect students across the cognitive, affective, and behavioral domains of environmental learning?; 2) What types of XR technology (VR, AR, MR) have been applied in ecoliteracy education?

2. METHODOLOGY

2.1. Research Design and Framework

This study employs a Systematic Literature Review (SLR) with a qualitative–quantitative synthesis to analyze research on Extended Reality (XR), particularly Virtual Reality (VR) and Augmented Reality (AR) in environmental education. The review aims to identify how XR contributes to students' ecological literacy across cognitive, affective, and behavioral dimensions. This study follows the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure transparency, replication, and academic rigor in the review process.

Database searches were conducted using Scopus and Google Scholar. Keywords used included ("Virtual Reality" OR "Augmented Reality" OR "Extended Reality" OR VR OR AR OR XR) AND ("Environmental Education" OR "Eco-Literacy" OR "Pro-

Environmental Behavior"). The search was limited to English and Indonesian articles published between 2015 and 2025.

Articles were excluded if they (1) did not have student participants, (2) did not analyze eco-literacy components (cognitive, affective, behavioral), (3) had no full-text available, or (4) were outside environmental education context. Although the search covered 2015-2025, all articles meeting inclusion criteria were published between 2020 and 2025, indicating that XR research in environmental education is a relatively new and rapidly developing topic in the last five years.

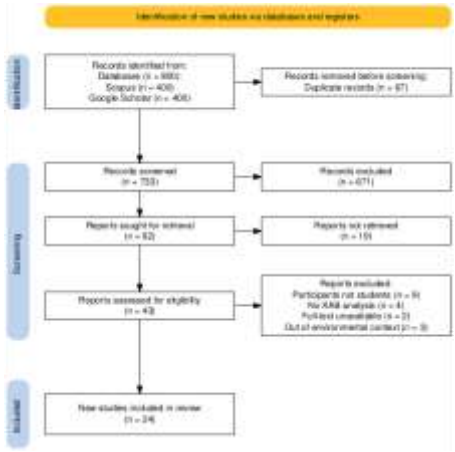

Figure 1. Research method following the PRISMA strategy (prepared by the authors).

2.2. Data Extraction and Synthesis

Data extracted included author, year, XR type, research design, participants, and key findings related to ecological literacy. Analysis used thematic and narrative approaches grouping results according to research questions.

3. RESULTS AND DISCUSSION

RESULT

3.1 Utilization of XR Technology

The diversity of XR technologies, which includes Virtual Reality (VR) and Augmented Reality (AR) provides different experiences for students.

Figure 2. Proportion of VR and AR Utilization in Environmental Education

Analysis shows a significant dominance of Virtual Reality (VR) over Augmented Reality (AR) in environmental education interventions, with 19 studies (79.2%) primarily utilizing VR due to its immersive potential for visualizing complex or inaccessible scenarios. Conversely, AR accounted for only 5 studies (20.8%), generally focusing on real-world integrated digital content. This disparity suggests that VR's immersion and spatial presence are currently perceived as the stronger mechanisms for influencing pro-environmental attitudes and behaviors.

3.4 Synthesis of XR's Impact on Eco-Literacy

The synthesis was conducted by grouping the impacts of XR based on the three main dimensions of eco-literacy, namely knowledge (cognitive), attitude (affective), and pro-environmental behavior.

3.4.1 The Influence of XR on Cognitive aspect

The cognitive dimension is the initial foundation for building students' ecological literacy. Of the 24 studies analyzed, 16 studies showed that the use of XR significantly improved students' conceptual understanding of complex environmental issues. This improvement occurred not only in terms of memorization or factual knowledge, but also in students' ability to understand cause-and-effect relationships in ecological systems.

Table 1. Summary of the impact of XR on the cognitive aspect

Source	Cognitive Focus
Adjanin & Brooks (2023); Tyski & Henderson (2024); Tabbu et al. (2024); Tan et al. (2024)	Significant improvement in climate literacy, self-efficacy, and understanding of climate change.
Liu & Yeh (2022); Liao et al. (2025); Gestiada et al. (2025); Fokides & Arvaniti (2020)	VR enhances conceptual understanding of ecology, learning motivation, and moves students to a higher level of conceptual mastery.
Simsek (2024); Chen et al. (2024); Michel-Acosta et al. (2024)	AR enhances understanding of life cycles, aurora-climate, and tropical cyclones with higher post-test scores and lower cognitive load.
Suryati et al. (2025); Lo and Tsai (2022); Fokides & Chachlaki (2020)	VR-PBL enhances critical thinking, climate awareness, and long-term knowledge retention about conservation.
Manoharan, A. P. S. (2025); Chen (2022)	VR enhances awareness of marine ecosystems; AR improves understanding of environmental concepts.

The cognitive effectiveness of Extended Reality (XR) is technology-dependent. Virtual Reality (VR) facilitating the understanding of macro and systemic concepts through immersive, spatial, and experiential learning. Conversely, Augmented Reality

(AR) is optimal for grasping specific and microscopic phenomena by reducing cognitive load via real-world integrated 3D visualization. Crucially, XR's cognitive benefits are often mediated by its integration with structured pedagogical models, promoting higher-order thinking and the construction of a deep understanding of complex environmental challenges.

3.4.2 The Influence of XR on Environmental in Affective aspect

In addition to increasing knowledge, XR has also been shown to have a strong impact on shaping students' positive affective toward the environment. Of the 24 studies analyzed, 20 showed significant affective changes, including increased ecological empathy, sense of place, and awareness of responsibility for nature conservation.

Table 2. Summary of the impact of XR on the affective aspect

Source	Affective Focus
Adjanin & Brooks (2023); Tyski & Henderson (2024); Tan et al. (2024); Chiang (2021); Plechatá et al. (2022); van Horen et al. (2024)	Increased engagement, sense of place, emotional attachment to the environment, and empathy through immersive VR experiences.
Spangenberger et al. (2024); Manoharan, A. P. S. (2025).	VR enhances connectedness to nature, feelings of awe, and transforms negative attitudes into positive ones toward environmental issues.
Liu & Yeh (2022); Liao et al. (2025); Fokides & Arvaniti (2020)	VR enhances positive attitudes, environmental awareness, appreciation for ecosystems, and motivation to learn about ecological issues.
Bhang & Huh (2023); Chen et al. (2024); Chen (2022); Simsek (2024)	AR increases awareness of air pollution, positive attitudes toward climate change, and environmental understanding with a high effect size (>0.9).
Suryati et al. (2025); Lo and Tsai (2022); Ho et al. (2024); Fokides & Chachlaki (2020)	VR increases climate change awareness (moderate→high), conservation motivation, and positive attitudes toward endangered species.
Roy T et al. (2025); Gestiada et al. (2025); Michel-Acosta et al. (2024)	Google Cardboard-based VR and 360° tours increase motivation, marine ecological awareness, and appreciation for natural phenomena.

The findings show that attitude changes through XR are driven by several affective mechanisms. VR's emotional presence allows students to directly experience environmental threats. Furthermore, phenomena like the overview effect and embodiment offer transformative perspectives, deepening the emotional connection to

nature. Simultaneously, AR personalizes abstract threats by visualizing previously invisible environmental risks. These mechanisms demonstrate that XR is critical for activating the emotional dimension, which drives authentic ecological awareness and responsibility.

3.4.3 The Influence of XR on Pro-Environmental Behavior

The behavioral dimension is the culmination of a holistic environmental learning process, where knowledge and attitudes are expected to be transformed into concrete actions. Of the 24 studies analyzed, 12 studies showed that the use of XR successfully increased students' intentions and motivation to behave in an environmentally friendly manner.

Table 3. Summary of the impact of XR on the behavioral aspect

Source	Behavioral Focus
Adjanin & Brooks (2023); Xiong et al. (2024); Plechatá et al. (2022); Ho et al. (2024)	VR increases environmental protection behavioral intentions, pro-environmental food choices, and behavioral intentions toward plastic waste.
Tyski & Henderson (2024); Tan et al. (2024); Liu & Yeh (2022)	VR increases participation in climate mitigation and problem-solving intentions, but actions remain individual.
van Horen et al. (2024); Spangenberger et al. (2024)	The VR overview effect enhances pro-environmental behavior through nature connectedness.
Bhang & Huh (2023); Chen (2022)	AR/VR changes 10 types of behavioral attitudes (effect size >0.9): cleanliness, masks, environmental responsibility.
Manoharan, A. P. S. (2025).; Chiang (2021); Fokides & Chachlaki (2020)	VR games enhance actual behaviors related to nature protection and conservation actions.

Behavioral change mechanisms through Extended Reality (XR) are mediated by several psychological pathways. Interactive VR experiences foster perceived autonomy and self-efficacy, which are crucial for mediating the transition from pro-environmental intention to actual action. Additionally, VR simulations offer opportunities for behavioral modeling, allowing students to safely practice decision-making before real-world application.

DISCUSSION

As outlined, various global environmental issues necessitate the urgency of environmental education (EE). In this context, the findings of these 24 literature reviews

reinforce the transformative potential of Extended Reality (XR), encompassing Virtual Reality (VR) and Augmented Reality (AR), as a key innovation in EE to enhance students' ecoliteracy across cognitive, affective, and behavioral aspects.

Cognitive Enhancement and Contextual Comparison

The results showing that XR enhances conceptual understanding and ecological knowledge through immersive visualization (Tabbu et al., 2024; Chen et al., 2024; Liao et al., 2025) align with and extend the views of constructivism and experiential learning. XR bridges abstract concepts with real-world phenomena, an aspect often difficult to achieve through traditional EE methods (pen-and-paper). The new insight is that this effectiveness lies in XR's ability to manipulate time and spatial scales, for instance, allowing students to witness the real-time effects of pollution or the lengthy process of the carbon cycle, which is impossible in conventional classroom settings.

Affective Development and Environmental Empathy

The strengthening of ecological empathy and sense of place through XR (Tyski & Henderson, 2024) reinforces the findings of contextual learning theories regarding the role of emotional involvement. Virtual exposure to environmental degradation elicits strong emotional responses, which are an essential prerequisite for forming authentic ecological concern. These findings complement non-XR research showing that digital storytelling strongly influences affect, but XR elevates this impact through richer visual and kinesthetic senses.

Behavioral Promotion and the Need for Further Study

The reported increase in intention and motivation to engage in pro-environmental actions (Plechatá et al., 2022; Xiong et al., 2024) indicates that XR successfully triggers action readiness. The key difference from other behavioral research is that XR effects are often short-term. While other studies focusing on community-based interventions show more stable behavioral change through social reinforcement and sustained programs, current XR results are limited to intent. This suggests that XR is highly effective as an initial catalyst for awareness and intent but needs to be integrated into broader EE programs and supported by social reinforcement to achieve sustained behavioral change.

Variations in Effectiveness and Design Considerations

The variation in effectiveness based on technology type (AR vs. VR) and student characteristics (Simsek, 2024; Tabbu et al., 2024; Gestiada et al., 2025) highlights the need for intelligent pedagogical design. These findings provide the insight that there is no one-size-fits-all XR solution. For example, AR excels in cognition for young learners due to lower cognitive load, compared to VR which is more suitable for complex simulations for adolescents. This underscores that XR effectiveness heavily depends on the alignment of the technology with the learning objective, the students' developmental level, and the complexity of the ecological content being delivered.

Implication for Practice

Governments and educational institutions, particularly in Indonesia, are encouraged to adopt XR as a powerful complementary tool in EE curricula, not as a replacement for outdoor experiences (Fokides & Chachlaki, 2020). Implementation should focus on: (1) Developing localized content to address specific Indonesian environmental issues; (2) Adequate teacher training in XR pedagogy; and (3) Innovative device procurement strategies to address infrastructural gaps and device availability.

Implication for Future Research

Future research must address the limitations of current studies by focusing on: (1) Longitudinal studies to measure the duration and sustainability of pro-environmental behavior change; (2) Using more objective quantitative methods (e.g., physiological measurements or real-life behavioral observation) rather than solely self-reports; and (3) Cost-effectiveness comparisons** among various types of XR in the context of schools in developing countries.

Limitations

Although promising, the existing evidence is limited by short intervention durations, small sample sizes, and reliance on self-report measures. Furthermore, the predominantly school-centered and geographically narrow research context hinders generalizability. The variation in findings between studiesfor instance, VR cognitive boost without behavioral impact versus AR behavioral change with modest cognitive gains (Bhang & Huh, 2023) also indicates the necessity for standardization of design and measurement in XR studies.

4. CONCLUSION

This review shows that Extended Reality (XR) meaningfully supports ecoliteracy by improving conceptual understanding, ecological empathy, and pro-environmental intentions, with VR offering the strongest immersive benefits and AR aiding younger learners through reduced cognitive load. Although promising, most evidence reflects short-term behavioral intentions, indicating the need for research on sustained impacts. Future work should explore long-term behavioral outcomes, cultural contexts such as Indonesia, and integration with pedagogical models, while educators are encouraged to use XR as a transformative tool for fostering environmental awareness and action.

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The Development Of "Domino Hijaiyah" Audio Flashcards To Improve Hijaiyah Reading Skills

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ABSTRACT

This study was motivated by the limited availability of interactive learning media that can help students aged 6–7 years old recognize and read Hijaiyah letters in an interesting and enjoyable way. Therefore, this study aims to develop interactive learning media in the form of audio flashcards called "Domino Hijaiyah" as a supporting tool to improve Hijaiyah letter reading skills. This study uses a quantitative approach with the Design and Development (D&D) method, which adapts the Planning, Production, and Evaluation (PPE) model, consisting of the planning, production, and evaluation stages. In the evaluation stage, the research subjects were determined purposively and involved two experts as media feasibility assessors, namely one subject matter expert and one media expert. The instruments used included expert validation sheets based on a 1–5 Likert scale and documentation, while the data were analyzed quantitatively through validity score calculations. The validation results showed that the material aspect scored 100% in the excellent category, while the media aspect scored 97.2% in the excellent category after revisions were made based on experts feedback. These findings indicate that the "Domino Hijaiyah" audio flashcards are highly suitable for use as interactive learning media to support the ability to recognize and read Hijaiyah letters. This study also shows that the developed media has the potential to be an innovative alternative for teachers and is recommended for further testing through field trials to measure its effectiveness directly in the classroom.

Keywords: *Arabic Literacy, Hijaiyah Dominoes, Hijaiyah Reading Skills, Interactive Audio Flashcards, Learning Media*

1. INTRODUCTION

Learning the Hijaiyah letters is a fundamental aspect of Islamic religious education, as these letters form the structure of the Qur'an. The ability to recognize, spell, and pronounce the Hijaiyah letters is not only a gateway for children to understand the Qur'an, but also part of the process of spiritual formation from an early age. Learning the Hijaiyah letters requires methods and media that are appropriate for children's development, namely through media that are interesting, interactive, and also in line with children's developmental characteristics. This is in line with Muinnah (2019), who states that learning media has an important role in attracting students' interest in learning and helping teachers deliver material more effectively.

However, learning the Hijaiyah letters in formal and non-formal educational institutions still faces a number of challenges. The methods used often rely on conventional media such as blackboards, lectures, and repetitive writing exercises.

Although these methods can help students, this type of learning is often less appealing to young children due to the lack of interactive and visual elements that can stimulate motivation to learn. Nisa & Darmawan (2025) emphasize that limitations in the use or variety of learning media can lead to a lack of motivation and enthusiasm among students during the learning process, which ultimately results in low engagement and poor learning outcomes among students.

The findings indicate that early childhood requires a learning approach that is more suited to their developmental characteristics, especially in terms of interactive and engaging media. A mismatch between learning media and children's needs can lead to boredom and a decline in learning motivation. This is in line with the opinion of Wahyuningsih & Setianingsih (2025), who stated that low interest in learning often arises when teaching materials are not presented through media that are appropriate for the child's developmental stage. Thus, there is a need for Hijaiyah learning media that can provide a fun learning experience and suit the learning styles of students, especially first-grade elementary school students aged 6–7 years.

Children aged 6–7 years have distinctive developmental characteristics; they are physically active, highly curious, and prefer game-based learning and social interaction. Therefore, learning media that are too abstract or do not involve activities are less effective for this age group. According to Dale (1946), children find it easier to understand concepts when they learn through concrete and multisensory experiences. This is reinforced by Maksuroh & Agustin (2025), who emphasize that visual media such as Hijaiyah letter cards designed with bright colors and attractive illustrations can help early childhood children recognize and remember the shapes of Hijaiyah letters more easily.

Previous studies have also shown that creative media can help students learn the Hijaiyah letters more effectively. Noterisa et al. (2024) also stated that the use of flashcard learning media can increase motivation and is considered effective in learning the Hijaiyah letters. Similarly, Purnamasari & Setiawan (2023) found that images can gradually strengthen children's understanding of Hijaiyah letters. Research by Khairiyah & Pasaribu (2024) also found that the use of flour media can increase student enthusiasm through direct learning experiences. Through direct interaction with flour, students are more focused and interested in recognizing letters. In addition, the use of puzzles as educational games has been proven to sharpen students' thinking and perseverance (Purnamasari & Setiawan, 2023). Various uses of media have been proven to provide better responses compared to conventional methods.

Other interactive media-based research has also been extensively developed, particularly in the field of learning the Hijaiyah letters. Lidianti et al. (2022) developed augmented reality-based learning media that allows students to scan images of letters to see three-dimensional visualizations of the Hijaiyah letters. Husniah et al. (2024)

showed that the application of interactive learning in the classroom can increase student participation and learning outcomes by up to 90%. These two studies confirm that interactive approaches, whether through technology or classroom methods, have a significant impact on the effectiveness of learning the Hijaiyah letters. The results of these studies show that good learning media can stimulate faster child development. However, innovations that combine visual, audio, social interaction, and educational game elements simultaneously are still rare.

Media with audio-based game formats like this have not been widely developed. In an effort to fill this gap, Hijaiyah Domino Cards were designed as a learning medium that combines educational games with audio support. This medium takes the form of physical domino cards with colorful and attractive Hijaiyah letters, equipped with markers or QR codes that contain audio pronunciations of the letters. The game mechanism follows the concept of dominoes, where students match cards until they run out to win the game. With this approach, students not only learn to recognize the shapes of letters, but also hear the correct pronunciation and interact actively through play.

Based on various findings and needs analyses that have been described, this study aims to answer several main issues related to the development of Hijaiyah letter learning media for first-grade elementary school students. The first issue relates to how the planning process for the Hijaiyah Domino Cards media is designed to suit the developmental characteristics of 6-7-year-old students and the needs of learning Hijaiyah letters. The second issue relates to how the production process of the media is carried out to produce a product that is ready for testing, both in terms of visual design, game mechanics, and audio feature integration. Furthermore, this study also attempts to answer how the evaluation results from subject matter experts and media experts regarding the suitability of the Hijaiyah Domino Card media that has been developed.

In line with the above problem formulation, this study aims to systematically describe the planning process of the Hijaiyah Domino Card media as interactive learning media designed according to the needs of first-grade elementary school students. It also aims to develop the Hijaiyah Domino Card media product in accordance with the developmental characteristics of students, both in terms of visual aspects, game functions, and audio integration. It also aims to assess the level of media feasibility through validation results from subject matter experts and media experts as a basis for determining the quality and feasibility of the product before further field trials are conducted.

2. METHODOLOGY

2.1. Research Design

The approach used in this study is a quantitative approach. According to Sugiyono (2013), a quantitative approach is an approach based on a positivist paradigm applied to a specific population or sample, using specific instruments in data collection, and performing statistical analysis of the data obtained for the purpose of testing hypotheses. The research methods used in this study are the Design & Development (D&D) method and the PPE (Planning, Production, Evaluation) development model and procedures developed by Richey and Klein. The D&D method is a systematic study of the design, development, and evaluation (PPE) process with the aim of establishing an empirical basis for producing learning or non-learning products and instruments, along with new or improved models to guide the development process (Richey & Klein, 2007). The Design & Development method achieves its various objectives through two main categories of research projects, namely the category of research that focuses on product and tool development, and the category of research that focuses on model development. In this study, the category used is product and tool research.

2.2. Participants of the Study

In the Evaluation stage of the PPE model used by researchers in this study, the product underwent a validation process involving subject matter experts and media experts to validate the developed product. This was done to measure the validity of the product before it was declared fit for use. There were two experts in this study, consisting of one subject matter expert and one media expert.

2.3. Instruments

The instrument used for expert judgement by subject matter experts and media experts is a questionnaire using a Likert scale of 1 to 5. Each questionnaire consists of four indicators adapted from the Learning Object Review Instrument (LORI) Version 2.0 of 2009 developed by John Nesbit, Karen Belfer, and Tracey Leacock.

The media expert and subject matter expert validation assessment aspects can be seen in Table 1 and Table 2 below.

Table. 1. Media Expert Judgement Instrument

No	Aspect	Number of assessment items
1	Presentation design	4
2	Interaction usability	1
3	Accessibility	2
4	Standards Compliance	2

No	Aspect	Number of assessment items
Total of assessment items		9

Table. 2. Subject Matter Expert Judgement Instrument

No	Aspect	Number of assesment items
1	Content quality	4
2	Learning Goal Alignment	3
3	Motivation	2
Total of assesment items		9

2.4. Data Analysis Techniques

The analysis technique applied in this study is quantitative analysis. Quantitative data is sourced from the validity assessment of learning media in the form of questionnaires that have been responded to by subject matter experts and media experts. Scoring for each item of the instrument uses the Likert scale. The data from the validation instruments of both types of experts serves as the basis for the analysis process. The following is the formula used:

$$Result = \frac{total\ score\ earned}{maximum\ score} \times 100\%$$

3. RESULT AND DISCUSSION

3.1 Result

The development output from this study is an educational media product named the Audio Flashcard "Domino Hijaiyah," primarily designed for students, especially those in Al-Quran Education (PAQ). The content provided in the Audio Flashcard "Domino Hijaiyah" focuses on basic hijaiyah letters tailored for students equivalent to first-grade elementary school level. The objectives of developing this product are: (1) to implement letter level sequencing to facilitate systematic learning and comprehension of hijaiyah letters, (2) to encourage student interaction thus enhancing their social skills, (3) to motivate students to learn through engaging game-based media, and (4) to support strategic thinking in card placement.

Generally, this interactive learning media is designed to introduce and improve students' understanding of hijaiyah letters through a domino card game format. By integrating learning and play elements, the students can more easily comprehend, recognize, and memorize hijaiyah letters. This game is not only enjoyable but also educational, promoting social interaction among peers. The learning media consists of

three difficulty levels: Level 1 begins with letters from *Alif* to *Ra'*, Level 2 from *Za'* to *Fa*', and Level 3 from *Qof* to lam *Alif*. It is hoped that students can learn progressively, starting with basic letters advancing to more complex ones.

The detailed development stages of the Audio Flashcard "Domino Hijaiyah" educational media are as follows:

3.1.1 Planning

This stage comprises two parts: student characteristic analysis and material analysis. Regarding student characteristics, Piaget's theory of cognitive development was adopted, revealing that students aged 6-7 years are in the symbolic thinking stage but are not yet fully capable of cognitive operations. Learning experiences aided by interactive learning media substantially support children in transitioning towards the concrete operational stage. At this age, children enjoy mentally representing objects through symbols or signs (Nainggolan & Daeli, 2021).

Material analysis considers that hijaiyah letters are part of the Islamic Religious Education curriculum. The learning using Audio Flashcard "Domino Hijaiyah" operationalizes the students' basic competencies in recognizing hijaiyah letters, including recognizing forms, spelling, and articulating letters correctly. The assessment focuses on cognitive and applicative basics: (1) letter name recognition, (2) identification of letter shapes including similar letters, and (3) correct pronunciation according to the basic sounds.

3.1.2 Production

The production involved designing cards measuring 14 cm by 7 cm (half the size of standard domino cards). The cards are made of 310 gsm Art Carton and laminated on both sides. The front design of each card features illustrations of two hijaiyah letters, positioned in the upper and lower columns respectively. The font used is clear and child-friendly. The back side includes a barcode functioning as a tool to assist with letter pronunciation if a student cannot yet read or articulate the front letters. Additionally, the color scheme includes bright and contrasting colors to attract students' attention. An illustration of the Audio Flashcard "Domino Hijaiyah" design accompanies the text.

Figure 1. Audio Flashcard "Domino Hijaiyah" Illustration

3.1.3 Evaluation

Evaluation was conducted through validity assessment by experts in material and media via expert judgement. The material validity was assessed by a PAQ At-Taqwa Bandung Islamic Religious Education teacher, and media validity by an Educational Technology lecturer at UPI. The validity results are presented in Table 1.

Table. 3. Expert Judgement Result

No	Validator	Percentage (%)	Evaluation Category
1	Material Expert	100%	Excellent
2	Media Expert	97,2%	Excellent

3.2 Discussion

The Audio Flashcard "Domino Hijaiyah" serves as a flashcard-based learning media supported by audio for students who face difficulties recognizing and reading hijaiyah letters. During the learning process, the media is not solely student-operated; teacher guidance is essential to facilitate the game at the beginning of the lesson. This approach aims to keep students motivated to learn hijaiyah letters continuously, minimizing frustration when transitioning letter recognition into concrete understanding.

Validity assessments conducted through surveys by material and media experts showed that the material component received a perfect score (100%) categorized as excellent. This encompasses aspects such as content quality, alignment with learning objectives, and motivational elements. Therefore, the material of the Audio Flashcard "Domino Hijaiyah" is suitable for students aged 6-7 to enhance their ability to read hijaiyah letters.

For the media aspect, the score was 97.2%, also rated excellent, covering presentation design, interaction usability, accessibility, and standard compliance. The media expert initially identified a concern regarding insufficient color contrast between certain hijaiyah letters and their background, which could reduce visual clarity for young learners. Specifically, the original design used light blue backgrounds with green letter outlines, creating a color combination that may be challenging for children aged 6-7 years to distinguish clearly. This feedback was addressed by revising the color scheme to employ brighter, high-contrast combinations such as pairing dark letters with light backgrounds and vice versa. This revision aligns with established principles in visual design for early childhood education, as Akbar (2022) emphasizes that appropriate color selection significantly influences student engagement and comprehension when using flashcard media. The revised design not only meets accessibility standards but also enhances the visual appeal necessary to maintain learner attention during

gameplay. This comprehensive result and discussion highlight the systematic development, educational value, and expert validation of the Audio Flashcard "Domino Hijaiyah," supporting its efficacy for early learners in hijaiyah letter recognition and reading skills.

This high level of feasibility can be critically analyzed through the lens of Jean Piaget's Theory of Cognitive Development, which posits that children aged 6–7 years are in the symbolic thinking stage. During this phase, learners begin to represent objects through symbols but still require scaffolding to transition toward concrete operational thinking. The utilization of domino cards as visual symbols, augmented by synchronized audio, provides the cognitive bridge necessary to minimize learner frustration when encountering the abstract structures of Hijaiyah letters.

Furthermore, the efficacy of this media is supported by the multisensory experience framework proposed by Edgar Dale (1946), which suggests that conceptual understanding is enhanced when learning involves concrete and diverse sensory engagement. By integrating visual stimuli—such as bright colors and engaging illustrations—with auditory output via QR codes, the media facilitates simultaneous visual and auditory processing. This alignment is consistent with the findings of Maksuroh & Agustin (2025), which emphasize that such multisensory approaches help early childhood learners recognize and retain letter shapes more effectively.

Critically, the game-based learning format of the dominoes addresses the challenges of low motivation often associated with conventional "blackboard and lecture" methods. As underscored by Nisa & Darmawan (2025), the variety and quality of learning media are primary determinants of student engagement levels. "Domino Hijaiyah" functions not only as a delivery mechanism for content but also as a platform for social interaction, strategic thinking, and collaborative play, thereby making the acquisition of literacy more humanistic and engaging. Technical refinements, such as improving color contrast based on expert feedback, further ensure that the media meets the visual perception standards required for early childhood education.

Despite the favorable validation results, this study has several limitations that warrant acknowledgment. First, the evaluation was limited to expert validation involving only two validators (one material expert and one media expert), without conducting field trials with actual students. While expert judgement provides valuable theoretical and technical assessment, it cannot fully capture students' authentic learning experiences, engagement levels, or actual improvement in hijaiyah letter recognition skills. Second, the study did not compare the effectiveness of 'Domino Hijaiyah' against conventional teaching methods through controlled experimental design. Third, the assessment focused solely on product feasibility rather than measuring direct learning outcomes such as retention rate, pronunciation accuracy, or long-term mastery of hijaiyah letters. These limitations suggest that while the media

demonstrates strong potential based on expert evaluation, empirical evidence of its pedagogical effectiveness remains to be established through comprehensive field testing.

4. CONCLUSION

This study successfully developed the *Domino Hijaiyah Audio Flashcard* as an interactive learning medium suitable for children aged 6–7 years. The validation results, which achieved scores of 100% for material quality and 97.2% for media design, indicate that the product meets high pedagogical and technical standards. The integration of visual, auditory, and game-based elements demonstrates strong potential to support early learners in recognizing and pronouncing Hijaiyah letters in an engaging learning environment.

From a practical perspective, this media contributes to Islamic early childhood education by offering an alternative instructional tool that aligns with children's developmental characteristics and learning preferences. Theoretically, the findings reinforce the relevance of multisensory and play-based learning approaches in supporting foundational literacy skills.

Future research should extend beyond expert validation by conducting large-scale field testing with more diverse student populations. Empirical studies are needed to measure learning outcomes such as long-term retention and pronunciation fluency compared to conventional instructional methods. Further investigation into secondary variables, including optimal play duration, teacher facilitation strategies, and audio accessibility in low-resource settings, is recommended to enhance the effectiveness and scalability of the media.

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An Analysis of Teachers' Understanding of Criterion Referenced Assessment Implementation in Kurikulum Merdeka

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ABSTRACT

This study investigates teachers' understanding of criterion-referenced assessment (CRA) within the context of the Kurikulum Merdeka. Although CRA is a fundamental component of competency-based education, its classroom application remains inconsistent based on what teachers understanding. Using a qualitative descriptive design, data were collected through semi-structured interviews with five teachers from SMP Islam Ummulqura Indonesia who have direct experience implementing the curriculum. The findings reveal that while teachers possess a general conceptual understanding of CRA, teachers often struggle to operationalize it effectively. Teachers commonly adopt existing rubrics without considering the students and experience difficulties in interpreting learning outcomes, formulating measurable indicators, and aligning assessment criteria with students' diversity. Nevertheless, they perceive this approach as providing more meaningful and personalized feedback that supports students' learning development. The study highlights that enhancing teachers' capacity through authentic assessment training and rubric development is essential to ensure the consistent application of criterion-referenced assessment. In conclusion, both conceptual and technical understanding among teachers need to be strengthened through continuous mentoring. This study recommends the development of practice-based training programs and professional learning communities to enhance teachers' assessment competence in alignment with the goals of the Kurikulum Merdeka.

Keywords: *assessment, assessment literacy*, *criterion referenced assessment, kurikulum merdeka*

1. INTRODUCTION

The improvement of educational quality cannot be separated from the assessment practices implemented in schools (Dempster et al., 2017). In the context of contemporary learning, assessment functions not only as a tool for measuring learning outcomes but also as a process that promotes the comprehensive development of students' competencies (Wiliam, 2011). Global shifts in educational paradigms emphasize the importance of authentic assessment, which prioritizes evidence of competency attainment rather than merely numerical scores (Djoub, 2017). This shift has influenced national policy directions in Indonesia, particularly since the introduction of the Kurikulum Merdeka, which positions assessment as an integral component of the teaching and learning process.

The Kurikulum Merdeka was introduced as a response to the dynamic demands of 21st-century learning, emphasizing differentiated instruction, character

development, and curricular flexibility (Anisa, 2022). Within this policy framework, assessment is conceptualized to support the continuous development of student competencies (Black & Wiliam, 2018). One of the key approaches promoted in this curriculum is criterion-referenced assessment (CRA), in which students' performance is evaluated against predefined competency standards rather than compared with their peers (Brookhart, 2012). This assessment model aligns with the goals of the Kurikulum Merdeka, particularly its aim to ensure that every learner achieves learning outcomes appropriate to their developmental stage (Arifin et al., 2021).

CRA plays a central role in enabling teachers to monitor student learning progression objectively and accurately (Tovani, 2023). Through CRA, teachers are encouraged to identify specific levels of competency mastery, design relevant instructional interventions, and provide evidence-based, constructive feedback (Yang et al., 2022). hus, CRA functions not only as an evaluative tool but also as a mechanism for ongoing instructional improvement (Brookhart, 2012). The effectiveness of CRA implementation will significantly determine the extent to which the Kurikulum Merdeka can achieve its intended outcomes, particularly in facilitating learning that is responsive to students' developmental needs (Arlinwibowo et al., 2023).

Despite its positive implications, numerous studies show that the successful implementation of CRA in schools is highly dependent on teachers' understanding of assessment concepts, procedures, and standards (Xu & Brown, 2017). Inadequate understanding may lead to misconceptions about the purpose of assessment, inaccuracies in establishing assessment criteria, and inconsistencies in providing meaningful feedback (DeLuca et al., 2018). Because CRA requires teachers to formulate clear achievement indicators and conduct evidence-based evaluations, limitations in conceptual knowledge or technical skill may hinder its effective application (Smith & Gillespie, 2023).

Previous research indicates significant variation in teachers' assessment literacy across the areas of planning, instrument development, and interpretation of assessment results (Meijer et al., 2023). Several studies also report that teachers are often more accustomed to using norm-referenced assessment (NRA), making the transition to CRA a substantial challenge (Velander et al., 2024). However, studies that specifically examine teachers' understanding of CRA within the context of the Kurikulum Merdeka remain limited (Sari & Murwaningsih, 2023). This gap underscores the need for research that explores teachers' perceptions, conceptual understanding, and implementation practices related to CRA in schools (DeLuca & Klinger, 2010).

Understanding teachers' level of knowledge regarding CRA is crucial, as teachers serve as key actors in the successful implementation of the Kurikulum Merdeka (Shulman, 1987). Without adequate understanding, CRA risks being applied merely for administrative compliance rather than contributing substantively to the improvement of

learning quality (Heritage, 2021). Therefore, investigating teachers' understanding is a strategic step toward identifying implementation barriers, professional development needs, and policy support mechanisms necessary to strengthen criterion-referenced assessment practices in schools (Mohammadkhah et al., 2022).

This study focuses on analyzing teachers' understanding of CRA implementation within the Kurikulum Merdeka, including their conceptual knowledge, technical abilities, and the difficulties they encounter. The findings are expected to contribute empirical insights to the field of educational assessment, particularly in the context of national curriculum transition. Furthermore, the results may serve as a foundation for developing more targeted and effective teacher training strategies to support assessment transformation in schools.

Considering these urgent needs and research gaps, this study is designed to provide a comprehensive portrayal of CRA implementation from the perspective of teachers as the primary practitioners in the field. A deeper analysis of teachers' understanding is expected to clarify the factors that influence the success of criterion-referenced assessment and inform necessary improvements at both policy and classroom practice levels. The following section outlines the methodology employed to obtain systematic and credible data for this study.

2. METHODOLOGY

2.1. Research Design

This study employed a qualitative descriptive research design to investigate teachers' understanding and implementation of criterion-referenced assessment (CRA) within the Kurikulum Merdeka framework. Qualitative descriptive research is appropriate for capturing participants' perceptions, practices, and challenges in their natural contexts without imposing predetermined theoretical structures. This design enabled the researcher to generate rich, detailed descriptions of teachers' assessment-related experiences and provide an in-depth understanding of how CRA is interpreted and implemented in real classroom settings.

2.2. Participants of the Study

Five he participants consisted of five teachers from SMP Islam Ummulqura Indonesia. A purposive sampling technique was used to select participants who met the specific criteria relevant to the study's objectives. Teachers were chosen based on their: 1) Direct involvement in implementing Kurikulum Merdeka, 2) Experience conducting classroom assessments, and 3) willingness to participate in an in-depth interview.

Purposive sampling ensured that the selected participants possessed the necessary knowledge and experience to provide meaningful insights into CRA-related

practices. All participants had at least one year of experience working with Kurikulum Merdeka.

2.3. Instruments

Data were collected using a semi-structured interview guide, which contained open-ended questions designed to elicit detailed responses. The instrument focused on three main areas:

1. Teachers' conceptual understanding of CRA,
2. How CRA is implemented in their classroom assessment practices
3. Challenges encountered during the implementation process.

Interviews were conducted online via video conferencing platforms to accommodate participants' schedules and ensure flexibility. Each interview lasted approximately 30–45 minutes. With participants' permission, all interviews were audio-recorded to ensure accuracy during transcription and analysis.

2.4. Data Analysis Techniques

With participants' consent, all interviews were audio-recorded and transcribed. The instrument was used to gather information on what teachers understand about CRA, how they apply it, and the challenges they encounter. The transcribed data were analysed using thematic analysis, involving coding, categorizing, and identifying key themes to interpret teachers' experiences and perspectives systematically. To enhance the credibility of findings, member checking was conducted by sharing preliminary interpretations with participants, allowing them to verify the accuracy and authenticity of the themes derived from their responses.

3. RESULT AND DISCUSSION

The findings indicates that teachers are familiar with the basic definition of criterion-referenced assessment (CRA), but their understanding remains largely conceptual and not yet supported by deep assessment literacy. This pattern is also widely reported in Indonesian assessment research, which states that teachers did not fully understanding the analytical processes required to implement it (Yusa et al., 2023). CRA demands teachers to evaluate students based on predetermined criteria rather than against peers, a shift that requires changes in mindset and technical competence (Scielzo et al., 2023). However, this studies confirm that many Indonesian teachers still perceive assessment primarily as a tool for grading rather than guiding learning. This explains they understand CRA at a declarative level but do not yet possess the procedural ability to apply it effectively. Moreover, Al Arsyadhi et al. (2024) acknowledges that the rapid rollout of Kurikulum Merdeka resulted teachers' capacity to carry out effective assessments remains below the expected standard.

A prominent barrier identified in this study is teachers' difficulty in designing assessment criteria that aligned with learning outcomes and student characteristics. Teachers often adopt existing rubrics without tailoring them to student needs. This struggle is frequently faced when educators attempt to translate abstract curriculum standards into concrete, actionable goals for the classroom. Instead teachers often adopt existing rubrics without tailoring them to student needs. This reliance on generic templates results in a "one-size-fits-all" context that fails to capture the nuances of individual student progress or specific local contexts. The root of this issue lies in the technical complexity of the task. Designing measurable indicators requires teachers to break down broad competencies into observable behaviors, a process that demands higher-order assessment skills (Stiggins, 2017).

The challenges in rubric development also stem from a shortage of clear guidelines and exemplars that could help teachers navigate this complex task. Teachers often find it hard to ensure rubrics are valid, reliable, and aligned with competency expectations, raising concerns about subjectivity and inconsistency in assessment outcomes (Bahar & June Maker, 2025). Many teachers face difficulties in translating broad competency goals into specific, observable criteria that accurately represent students' mastery levels (Rohma & Sa'adah, 2025). This problem is compounded by the challenge of designing rubrics that objectively capture these criteria, as rubric development demands a precise articulation of expected competencies at various performance levels (Wardana, 2024).

However, the curriculum explicitly mandates that assessment should tailored to students' diverse readiness levels, interests, and learning contexts (Standar Badan Kurikulum, 2024). This principle of differentiation reflects the "Merdeka" (freedom) concept itself and teachers are granted autonomy to design learning experiences that respond to their students' unique needs rather than following rigid, standardized approaches. The process can be both cognitively demanding and time-consuming in adopting the new CRA system effectively, especially when teachers must balance this work with substantial administrative responsibilities. Additionally, limited access to resources and insufficient ongoing professional development hinder teachers' ability to confidently craft and adapt rubrics that reflect both the curriculum's intentions and students' individual contexts.

Despite the challenges, teachers view CRA as more meaningful and capable of providing clear, meaningful feedback that supports students' individual learning progress. This positive perception aligns with the rationale behind Kurikulum Merdeka, which positions assessment as a continuous, feedback-driven, student-centred process. The teachers' appreciation of CRA reflects an understanding that the shift from norm-referenced assessment to criterion-referenced assessment in Indonesia curriculum reflects the direction of modern curriculum reform as stated by Henson (2015).

However, This disconnect between aspiration and implementation is not unusual in educational reform. Teachers often embrace reform ideals before developing the skills and resources necessary to enact them. The challenge for education authorities is to leverage this positive disposition by providing the practical support systems teachers need to translate their beliefs into effective practice.

Furthermore, the findings between teacher understanding and implementation underscores the need for more intensive, practice-oriented professional development. This finding has direct implications for achieving Kurikulum Merdeka's implementation goals. The curriculum's success depends not merely on policy dissemination but on building teachers' capacity to exercise the pedagogical autonomy it grants them. As Pastore (2023) stated that teachers' professional growth develops gradually through a complex, iterative learning process shaped by pre-service and in-service education, various training-related factors (such as duration, content knowledge, and learning opportunities), and ongoing teaching experience alongside contextual influences like collaboration with colleague, school involvement, and professional standards. It shows that effective assessment practice requires opportunities for teachers to examine student work collaboratively.

4. CONCLUSION

This study concludes that teachers implementing Kurikulum Merdeka demonstrate a general conceptual understanding of criterion-referenced assessment (CRA), yet continue to experience significant difficulties in applying it effectively in classroom practice. While teachers recognize CRA as an assessment approach grounded in predetermined learning standards and appreciate its potential to support individualized feedback, their procedural and technical assessment skills remain limited. In particular, challenges persist in interpreting learning outcomes, formulating measurable indicators, and developing context-responsive rubrics.

The findings of this study contribute to the existing literature by going beyond discussions of policy readiness and highlighting the concrete classroom-level realities of CRA implementation. By focusing on teachers' lived experiences, this research shows that the reliance on generic rubrics is not merely a matter of limited knowledge but also reflects constraints related to workload, time availability, and insufficient technical guidance. This insight adds nuance to previous research on assessment literacy and offers a clearer explanation of why CRA implementation often remains inconsistent.

Importantly, the study also demonstrates that teachers' positive attitudes toward CRA represent a valuable foundation for reform. Teachers perceive CRA as more meaningful and aligned with the principles of Kurikulum Merdeka; however, without sustained, practice-oriented professional development, this potential cannot be fully

realized. Therefore, strengthening teachers' assessment capacity should be viewed as a critical requirement rather than an optional support mechanism in curriculum reform.

Based on these findings, several implications emerge. School leaders should provide structured opportunities for collaborative assessment work, including rubric development workshops and peer discussions focused on student work analysis. Teachers are encouraged to engage in reflective and collaborative practices to gradually enhance their procedural assessment competence. For policymakers, continuous professional development programs emphasizing hands-on CRA application—rather than one-time training sessions—are essential.

In conclusion, achieving the goals of Kurikulum Merdeka requires bridging the gap between conceptual understanding and practical implementation of criterion-referenced assessment. This study underscores that meaningful assessment reform is contingent upon sustained professional support, contextual sensitivity, and the development of teachers' technical expertise. Strengthening these dimensions will enable CRA to function as an authentic tool for supporting student learning and realizing the curriculum's vision of competency-based education.

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Leveraging the Science of Learning and Development (SoLD) to Enhance Teacher Competencies

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ABSTRACT

Teacher competence is a key factor in achieving quality education, particularly in the context of implementing the Merdeka Curriculum in Indonesia. Recent advances in neuroscience and developmental science, compiled within the Science of Learning and Development (SoLD) framework, provide new insights into how humans learn and develop holistically, encompassing cognitive, emotional, social, and contextual dimensions. However, teachers' understanding of SoLD principles and their application in pedagogical practice remains limited, thereby hindering the optimization of learning environments that align with students' developmental potential. This research aims to analyze the benefits of SoLD principles for enhancing teacher competence through a qualitative literature review. The research methodology employs a qualitative approach utilizing library research with content analysis techniques applied to relevant literature. Findings demonstrate that teachers' understanding of brain malleability, individual developmental variability, and cognitive flexibility can fundamentally transform their pedagogical approaches. Teachers who implement SoLD principles undergo a paradigm shift from the traditional knowledge transmission model to facilitators of meaningful knowledge construction, with the capacity to create inclusive, responsive, and psychologically safe learning environments for all students.

Keywords: *curriculum development, science of learning and development***,** *teacher competence*

1. INTRODUCTION

Quality education constitutes an essential foundation for human resource development and national advancement. In this context, teachers hold an exceptionally strategic and significant role as agents of change capable of optimizing the potential of learners. Teacher competence, as a key determinant of learning success, has become a serious focus of attention in both national and international educational policies. However, despite the widely acknowledged importance of teacher competence, numerous challenges persist in its field implementation, particularly regarding comprehensive and sustainable professional development.

Recent research in neuroscience and developmental science has provided profound insights into how humans learn and develop. These findings demonstrate that learning is not merely a process of knowledge transmission, but rather a complex and dynamic process encompassing cognitive, emotional, social, and contextual dimensions (Cantor et al., 2018; Darling-Hammond et al., 2019a). Research on teacher professional development indicates that effective professional development programs must involve deep, collaborative, and sustained learning, rather than short-term training

disconnected from practical classroom contexts (Darling-Hammond et al., 2019b). Professional development programs connected to authentic classroom practice and involving ongoing reflection produce significant improvements in teachers' pedagogical competence.

Science of Learning and Development (SoLD) represents a synthesis of contemporary research that integrates knowledge from multiple disciplines, including neuroscience, psychology, anthropology, and sociology, to understand how individuals learn and develop within their environmental contexts (Lee et al., 2024; Osher et al., 2018). SoLD is a holistic approach that combines understanding of brain plasticity, learning dynamics, and individual uniqueness in the learning process (Heni, Iriani, & Ismanto, 2023). The SoLD framework is grounded in the understanding that every child possesses tremendous potential to learn and develop, and that environment, relationships, and experiences exert significant influence on this development. Darling-Hammond (2020) articulates practical implications of SoLD demonstrating that children's learning and development are influenced by dynamic interactions among environmental factors, relationships, learning opportunities, and interconnected physical, psychological, cognitive, social, and emotional processes. This framework indicates that learning is not merely a cognitive process, but rather a holistic experience encompassing emotional, social, and contextual dimensions.

SoLD research establishes conclusions on six fundamental principles. First, malleability, or brain plasticity, demonstrates that brain structure and function can change throughout life through quality experiences and relationships (Gola, Angioletti & Coco, 2022; Cantor et al., 2018). Second, integrated learning recognizes that cognitive, academic, social, and emotional aspects of development are intimately interconnected and work together to produce learning (Osher et al., 2018). Third, the presence of strong and trustworthy relationships constitutes an essential foundation for optimal learning and development (Oshima et al., 2023). Fourth, context and environment exert profoundly defining influences on development, including experiences, physical environment, culture, and social factors.

Fifth, individuality emphasizes that each individual possesses a unique developmental pathway (Rose, 2021), and no single approach can serve all learners. Sixth, meaning-making demonstrates that individuals construct understanding by reflecting on connections between new information and existing knowledge (Oshima et al., 2023). These findings hold profound implications for how teachers must develop their competence in daily learning practice.

Teacher competence is defined as an integrated ability encompassing diverse aspects that enable teachers to perform their functions effectively within learning contexts. According to Indonesian Education Standards, teacher competence comprises four primary dimensions: pedagogical competence, personal competence, social

competence, and professional competence. Pedagogical competence includes deep understanding of learners, ability to design and implement learning, and capacity to evaluate learning outcomes. Professional competence involves mastery of learning content and understanding of theories supporting learning (Bagou & Suking, 2020).

Contemporary research indicates that 21st-century teacher competence must expand to include new skills such as critical thinking, creativity, collaboration, and communication. Gümüş (2022) identifies that 21st-century teacher competence encompasses four clusters: ways of thinking (creativity, critical thinking, problem solving), working tools (information literacy, technology literacy), ways of working (communication, collaboration), and life in the world (citizenship, life and career skills). These competencies must be integrated into teachers' learning practice to prepare learners to face future challenges. Teacher professional development programs often fail to reflect contemporary understanding of how humans learn and develop. Furthermore, many professional development programs have yet to integrate understanding of neuroscience and developmental science into their design and implementation.

In the Indonesian context, research on teacher competence in curriculum development has revealed that significant gaps persist between theoretical foundations and field implementation practice. Limited research explicitly integrates the SoLD framework with teacher competence development in the Indonesian context. Most research on teacher competence development remains focused on traditional competencies limited to pedagogical and professional dimensions, without integrating deeper understanding of how learners learn based on contemporary neuroscience and developmental science research. This creates a significant gap between scientific knowledge about learning and current teacher competence development practices. Based on the preceding discussion, the research problem is: How can Science of Learning and Development be utilized to identify teacher competencies needed in developing learner-centered curriculum?

This article contributes by integrating the Science of Learning and Development (SoLD) framework as a foundation for reconstructing teacher competence within the context of curriculum development in Indonesia. The scientific novelty of this article lies in several important aspects. First, this article translates empirical findings from SoLD that have been validated through various studies in international educational contexts into a framework relevant to the Indonesian education system.

Second, this article provides understanding of how the six primary dimensions of SoLD (malleability of brain, integration of learning, relationship, context, individuality, and meaning making) can be translated into specific competencies teachers must possess in developing curricula responsive to individual learner needs. Third, this article demonstrates that SoLD-based teacher competence development not only enhances

the quality of academic learning, but also supports holistic learner development, including social, emotional, and identity dimensions.

Fourth, this article proposes the perspective that teacher competence development policy must shift from one-size-fits-all approaches toward adaptive, collaborative, and sustainable approaches, aligned with SoLD principles themselves. Thus, this article examines not only "what" competencies are needed, but also "how" teachers can develop these competencies through meaningful and contextual learning.

The perspective of educational equity also constitutes an important consideration in addressing this problem (Ainscow, 2020). Hammond (2019) and Themane's (2024) research on SoLD implementation in South African schools demonstrate that achieving meaningful educational transformation requires deeper understanding of how issues of race, ethnicity, gender, and poverty affect learning and development. Teachers must develop culturally responsive pedagogical content knowledge to effectively support all learners' learning within their zones of proximal development. Based on the problem and proposed solution approach outlined, this article aims to analyze fundamental principles of Science of Learning and Development into a teacher competence development framework. Additionally, it aims to explore effective strategies and models for teacher professional development in enhancing SoLD-based competence.

2. METHODOLOGY

This research employs directed qualitative content analysis, a deductive approach to examine how the Science of Learning and Development (SoLD) framework enhances teacher competence. Qualitative content analysis is a systematic approach to analyzing textual data through identification of recurring themes, patterns, and meanings within content. This method is particularly suitable for understanding how SoLD principles (brain malleability, integrated learning, relationships, context, individuality, and meaning-making) interact with teacher competency dimensions including pedagogical knowledge, professional skills, and socio-emotional capabilities (Bijker et al., 2024; Braun & Clarke, 2019). This research utilized library research examining scholarly documents (2018-2024) comprising peer-reviewed articles on Science of Learning and Development, teacher competence frameworks, and curriculum development research. Selection criteria prioritized direct relevance to SoLD principles, teacher competence development, and empirical grounding (Nicmanis, 2024).

The unit of analysis comprised themes and meanings related to teacher competencies and SoLD principles integration. Analysis followed three systematic phases: (1) Coding guide development based on predefined SoLD principles and competency dimensions with anchor examples; (2) Open coding identifying meaning units and preliminary codes, organized into subcategories through inductive abstraction; (3) Axial coding using constant comparison, linking codes to competency

dimensions and identifying emergent themes. Detailed coding manual development, constant comparison across sources, and triangulation procedures ensured credibility and transferability of findings.

3. RESULT AND DISCUSSION

Qualitative content analysis of literature reveals that integration of Science of Learning and Development (SoLD) principles significantly enhances the three dimensions of teacher competence: pedagogical competence, professional competence, and socio-personal competence. The first finding demonstrates a fundamental transformation in teachers' pedagogical approaches through understanding learning dynamics via the SoLD lens. Hammond (2019) identifies that teachers who comprehend learners' brains as dynamic and malleable systems implement more inclusive and responsive teaching practices. Teacher pedagogical competence encompassing understanding of learner characteristics exerts significant influence on students' critical thinking abilities. Research data demonstrate a strong correlation between teachers' understanding of developmental variability and their capacity to design effective differentiated learning.

The second finding reveals the role of multiple ways of knowing in creating holistic learning environments. Munro (2023) demonstrates that effective teachers integrate episodic, procedural, emotional, social, and self-identity knowledge in learning design. The Learning Policy Institute and Turnaround for Children affirm that when learning simultaneously integrates cognitive, social, and emotional dimensions, students achieve psychological safety that enables deeper intellectual engagement.

The third finding confirms that positive relationships between teachers and students function as essential foundations for learning. Osher et al. (2018) explain that warm, responsive, and consistent teacher-student relations biologically shape students' brain architecture through oxytocin and cortisol hormone regulation. Ruhimat et al. (2025) found in research conducted in Jakarta's remote areas that training programs emphasizing positive relationship building generated significant changes in teachers' instructional practices.

The fourth finding demonstrates strengthening of teachers' professional competence through pedagogical content knowledge enriched by SoLD understanding (Thompson & Smith, 2024). Darling-Hammond et al. (2019, 2022) identify that teachers who comprehend how brains process information, form schemas, and consolidate memory are capable of designing learning that facilitates meaningful knowledge construction. Hammond (2019) found that teachers integrating culture and cognition recognize that students' cultural mental models function as important cognitive hooks for effective learning.

The fifth finding reveals that teachers with strong metacognitive capacity and adaptive expertise are more effective in facilitating self-directed learning. Darling-Hammond et al. (2022) demonstrate that teachers explicitly modeling metacognitive strategies generate students who are more capable of planning, monitoring, and evaluating their own learning. Amilda and Jumhur (2024) found that professional development programs tailored to teachers' actual needs result in more effective implementation.

The sixth finding concerns the effectiveness of SoLD-based professional development programs. Darling-Hammond et al. (2020) prove that intensive, ongoing support directly connected to authentic classroom practice is far more effective. Professional learning communities based on SoLD facilitate teachers sharing effective practices and developing collective understanding about applying learning neurobiology within local contexts.

This research findings address the central question: How can Science of Learning and Development enhance teacher competence holistically? The emerging answer is through paradigmatic transformation in how teachers understand, design, and implement learning. SoLD integration does not merely add new knowledge, but transforms the fundamental lens through which teachers view learning.

When teachers understand that intelligence is malleable, they shift mindset from "some students can learn, some cannot" to all students can develop with appropriate support (A Howard-Jones, Jay, & Galeano, 2020). This epistemological shift is crucial because it directly affects pedagogical decisions, teacher expectations, and quality of classroom interactions. Munro's (2023) findings on multiple ways of knowing enrich understanding of complex and multimodal learning. Effective learning cannot be unimodal, but must accommodate diverse ways students process knowledge, integrating dimensions of identity, emotion, and social context.

Interpretation of positive relationships' role brings neuroscience perspective into relational learning theory. The finding that positive relations biologically shape students' brains through hormonal regulation provides strong scientific evidence for why "relationships are the primary process through which learning occurs." This is not merely a motivational slogan, but a fundamental neurological reality, transforming the framing from "relationships are a side effect of learning" to "relationships are the pedagogical foundation."

This research findings integrate SoLD with the established teacher competence framework. Findings on pedagogical content knowledge (PCK) enrich the traditional concept with neuroscience dimensions. Teachers must not only master content and how to teach it, but also understand how students' brains process the material, form mental schemas, and consolidate long-term learning. This creates more sophisticated and evidence-based PCK.

Findings on culturally responsive pedagogy integrate with teacher socio-personal competence theory. The interpretation is that cultural responsiveness is not merely a good social value, but a neurological imperative for effective learning. When teachers disregard students' cultural mental models, they lose the cognitive hooks that should facilitate learning. This transforms the framing from "culture is something that must be accommodated" to "culture is the fundamental architecture for learning."

Findings on adaptive expertise enrich the concept of teacher professional development. Effective programs are those tailored to teachers' actual context and needs, not top-down mandates. This aligns with SoLD principles themselves that adult learning requires personalization and responsiveness to context, creating coherence between what is taught about learning and how teachers themselves learn.

Transformative SoLD-based professional development programs must combine five essential elements: (1) intensive initial learning about SoLD principles; (2) collaborative learning communities with colleagues; (3) coaching and mentoring in practice implementation; (4) reflection spaces for critical examination; (5) leadership development for becoming change agents. The finding that collaborative learning produces collective understanding and sustained implementation modifies conventional wisdom about professional development that often remains individual and decontextualized. SoLD-based professional learning communities are not merely opportunities for sharing best practices, but essential mechanisms for collective sense-making about applying neuroscience principles within specific local contexts. Within the Indonesian context, these research findings are highly relevant given learner diversity and diverse learning contexts. SoLD principles can be applied across various Indonesian contexts. This opens opportunities to develop SoLD-based teacher development programs that are culturally adapted and resonate with the Merdeka Curriculum and Indonesian educational philosophy emphasizing character formation and holistic competence development.

4. CONCLUSION

This research addresses the central question of how Science of Learning and Development (SoLD) enhances teacher competence holistically. Integration of SoLD principles significantly enriches the three dimensions of teacher competence: pedagogical competence develops through understanding that intelligence is malleable and learning requires differentiated approaches; professional competence is enriched through pedagogical content knowledge informed by neuroscience; socio-personal competence is enhanced through understanding that positive relationships constitute the biological foundation of learning. Furthermore, this transformation achieves maximum effectiveness when teachers integrate multiple ways of knowing and develop adaptive expertise to facilitate self-directed learning. In conclusion, SoLD

is an epistemological lens that transforms how teachers think and act, creating teacher competence that is more integrated, evidence-based, and humanistic.

Based on these findings, recommendations are offered to various stakeholders. First, educational policymakers are advised to integrate SoLD in the development of national curricula and teacher competence frameworks, particularly the Merdeka Curriculum, supporting this through intensive professional development programs connected with authentic classroom practice. Second, higher education institutions and teacher development organizations are advised to develop SoLD-based programs combining conceptual learning, collaborative learning communities, coaching, reflection spaces, and leadership development, with attention to cultural adaptation and implementation across diverse Indonesian contexts. Third, teachers and educational practitioners are advised to actively develop understanding of how students learn through the SoLD lens, build professional learning communities with colleagues, and continuously reflect on and adapt pedagogical practices based on evidence. Through SoLD integration, Indonesia's educational ecosystem will become more responsive and effective in supporting meaningful learning and holistic development of learners.

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Strategies Implementing Deep Learning for Children with Special Needs in The Digital Era

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ABSTRACT

This study was conducted due to limitations in the application of deep learning integrated with digital technology for children with special needs. This is due to differences in the abilities and needs of each individual, which require adaptive, contextually relevant, and enjoyable learning strategies. The purpose of this study is to analyze the application of deep learning for children with special needs. This analysis covers the planning, implementation, evaluation, obstacles, and solutions carried out by teachers at Special Schools. This study uses a qualitative approach with in-depth interviews with a special education teacher who has 15 years of experience and has implemented a deep learning approach and a contextual project-based learning model. The results of the study show that learning must be student-centered, oriented towards real experiences, and integrate adaptive technology in vocational skills learning to support their independence after graduating from school. Evaluation is carried out comprehensively through formative and summative assessments to assess students' understanding, application, reflection, and emotional well-being, thereby supporting conscious, meaningful, and enjoyable learning. The main obstacle faced, namely differences in student abilities, was overcome through alternative assessments and teacher flexibility in designing learning strategies. The success of deep learning was also supported by partnerships between schools, parents, and the government. In conclusion, the implementation of deep learning for students with special needs is highly dependent on good initial assessment, adaptive and contextual teaching strategies, and an inclusive learning environment that supports students' cognitive and emotional aspects. Recommendations from this study emphasize the importance of developing interactive media and adaptive educational technology as inclusive educational innovations that can improve the quality of learning in the digital age.

Keywords: *Deep Learning, Digital Era, Special Needs Education*

1. INTRODUCTION

Technological developments in the digital age have had a major impact on various fields, including education. Special education for children with special needs has also felt the impact of these changes (Riyadi et al., 2025). Students with disabilities often face difficulties arising from cognitive demands, which are exacerbated by the lack of differentiated content, limited support systems, and limited access (Kauts, 2021; Strogilos et al., 2023). However, the application of deep learning integrated with digital technology for children with special needs still faces various limitations. This is evidenced by reports that there are only 4,695 special education teachers, while the number of students with special needs reaches 135,874 (Aranditio et al., 2023). This is

a serious obstacle regarding the shortage of educators with inclusive education competencies for the implementation of adaptive and deep learning for students. The main challenge arises from the different characteristics of each child, both in terms of abilities, obstacles, and the needs of each student through appropriate, contextual, and enjoyable learning strategies (Akmal et al., 2025; Biggs & Tang, 2011; Dinata et al., 2025; Diputera et al., 2024; Kolb, 2014).

Deep learning emphasizes students' learning abilities consisting of three main elements, namely meaningful learning, mindful learning, and joyful learning. This approach is important for children with special needs because it requires a learning process that is not only informative but also applicable to support their cognitive, social, and vocational development (Schall et al., 2012; Westwood, 2008). The universal design learning framework provides guidance that effective learning for students with diverse needs must provide variety in information representation, engagement methods, and forms of expression, so that each student can access learning according to their learning style and capacity (CAST, 2024; Kelly et al., 2022; Meyer et al., 2014).

In the context of education in special schools, deep learning is often associated with an experience-based and project-based approach, where students develop the functional and vocational skills needed in daily life (Kolb, 2014). Adaptive technologies such as interactive multimedia, assistive devices, and digital learning applications can be important tools in supporting deep learning, especially for students who need additional support in communication, literacy, or motor skills (Chahal et al., 2024; Şanal, 2023). However, obstacles still arise related to limited teacher competence, a lack of accessible digital media, and the suboptimal formative and summative assessments needed to evaluate the deep learning process (Salvia et al., 2017). These challenges require creativity and flexibility from teachers in adjusting teaching strategies to remain inclusive and meaningful.

This study formulates strategies for integrating deep learning theory and adaptive technology into learning design. This study aims to analyze the obstacles and opportunities for implementing deep learning supported by digital technology for children with special needs, develop contextual and responsive learning strategies for students, and produce recommendations for digital technology-based instructional design that can support the cognitive, social, and vocational development of students in the context of education.

2. METHODOLOGY

This study aims to analyze the application of deep learning in special needs education in the digital age, focusing on planning, implementation, evaluation, obstacles, and solutions applied. Research data was obtained from in-depth interviews as the main source, supported by information about the curriculum and teaching and

learning activity reports. To analyze the data, a thematic approach was used to identify patterns or main themes, such as the use of adaptive technology and the role of collaboration between stakeholders. The sampling method used purposive sampling to select appropriate participants, with the sample characteristics consisting of experienced teachers in special schools. Prior to analysis, a pre-analysis phase was conducted, including instrument testing through pilot interviews to ensure the consistency and relevance of the questions, as well as the use of data triangulation to strengthen the validity of the research findings.

2.1. Research Design

This study uses a qualitative approach with an exploratory study design. The qualitative approach was chosen to understand the personal experiences of participants in the context of special education, while the exploratory study design allows for in-depth analysis of one teacher who represents the application of deep learning in special schools. This design is in line with the research objectives, which are to explore implementation strategies that are appropriate to the context, rather than statistical generalizations, and to enable the integration of research results with theories such as universal design for learning.

2.2. Participants of the Study

The main participant in this study was a special education teacher with 15 years of experience in special schools. She has applied deep learning methods and contextual project-based learning models. The sampling technique used purposive sampling, which is sampling based on specific criteria, namely experience and expertise in the field of inclusive education, so that participants could provide in-depth insights. The number of participants was limited to one main participant so that the analysis could focus on an in-depth qualitative approach. The sample characteristics consisted of a relevant educational background, namely Special Education, as well as direct experience in a school environment, which enabled discussion of obstacles such as resource limitations and solutions through a partnership approach.

2.3. Instruments

The main instrument used was a semi-structured interview guide containing 15 to 20 open-ended questions related to the application of deep learning, such as “How do you plan student-centered learning for students with special needs?” and “What are the main obstacles to integrating adaptive technology in special schools?”. This guide was used in face-to-face interviews with key participants, with each session lasting approximately 60 to 90 minutes. Additionally, supplementary instruments included field observation notes and school documents, such as curricula and student evaluation

reports, as a means of strengthening data validity through triangulation. These instruments were administered to teachers through face-to-face interviews, with the recording process using video recordings to ensure the accuracy of the transcripts.

2.4. Data Analysis Techniques

The data obtained from interviews and documentation studies were analyzed using a thematic analysis approach. This technique was chosen to identify, categorize, and interpret the main patterns related to the implementation of deep learning in special needs education. The analysis began with a pre-analysis stage, in which all interview recordings were transcribed verbatim, and observation notes were organized to ensure completeness and clarity. At this stage, the researchers also conducted an initial reading to gain a comprehensive understanding of the data set.

The next step involved the team understanding specific data that reflected important concepts such as the use of adaptive technology, learning planning, student engagement, evaluation practices, and obstacles in the learning environment. This was done manually to maintain proximity to the data and allow for nuanced interpretations of the research team's experiences.

After understanding certain data, the team then aligned their perceptions of the main components of this research topic, starting from the implementation of deep learning, including teaching strategies, technology integration, collaboration between stakeholders, and solution-oriented practices. After that, the discussion topics were reviewed and refined to ensure their suitability with the research objectives and theoretical framework, such as universal design for learning.

To strengthen the credibility of the findings, triangulation was carried out by cross-checking interview data with documents such as curriculum plans and evaluation notes that had been submitted by the informants during the interviews. The analysis ended with an interpretation phase, in which themes were synthesized to provide an in-depth understanding of how deep learning is applied in the context of special schools, including the challenges faced and solutions designed by the participants.

3. RESULT AND DISCUSSION

a. Implementation of Concrete and Contextual Deep Learning Stages

The main finding of this study shows that effective deep learning implementation is not the application of a radical new theory, but rather the reinforcement and internalization of fundamental student-centered pedagogical practices. This finding aligns with the characteristics of deep learning where learning should implement the principles of being meaningful, mindful, and joyful, realized through a three-stage process (understanding, applying, reflecting) and supported by contextual partnerships (Kemendikdasmen, 2025).

In the IPAS subject, for example, learning on the topic of waste management is designed as a continuous project using a Project-Based Learning approach. Project-Based Learning (PjBL) is seen as a "great vehicle for meaningful inclusion" because its design elements and teaching practices consistently incorporate these key markers (Uliasz, 2016). This project is not limited to a single subject but is carried out by integrating multiple disciplines. The project is not completed in a single meeting but is implemented gradually to provide more meaningful learning experiences for students. This finding directly supports Kolb's (2014) argument regarding the importance of an experience-based approach. The three-stage process (understanding, applying, reflecting) can be interpreted as a practical application of the experiential learning cycle.

The understanding stage is conducted by introducing basic concepts related to healthy and unhealthy environments. Students are invited to observe environmental conditions, such as the presence of scattered waste, and recognize various types of waste they encounter in daily life. This approach helps students connect learning materials with real-world experiences in their surroundings. The applying stage involves direct activities, such as picking up and sorting waste in the school environment. Additionally, the learning activity includes visits to waste processing facilities, allowing students to witness the sorting process firsthand. The reflecting stage is not limited to having students retell their experiences but also aims to encourage them to apply these behaviors in daily life. For instance, when they notice a dirty area at home, they are expected to initiate cleaning it, or when encountering plastic waste, they should be able to sort it correctly. Thus, reflection is understood as a process of internalization reflected in behavioral changes, not merely a verbal activity at the end of the lesson.

b. Functional Partnerships

The interview findings indicate that deep learning for children with special needs is fundamentally dependent on functional partnerships among schools, families, and the wider community. Rather than serving as supplementary support, these partnerships emerged as a central enabler of deep learning implementation, particularly in sustaining meaningful, mindful, and joyful learning processes beyond the classroom. This finding confirms that deep learning in special education cannot be effectively designed or maintained without a collaborative learning ecosystem in which responsibilities are shared across multiple actors.

In this context, functional partnerships operate as contextual learning mechanisms that connect instructional goals with students' real-life environments. Schools act as the primary designers and facilitators of learning experiences, families reinforce learning continuity and behavioral internalization at home, and community institutions provide authentic contexts that support experiential and vocational

learning. This three-way collaboration aligns with prior research emphasizing that special education requires schools, communities, and service providers to unite as partners with families to create optimal learning conditions (Walker et al., 2022) and to make a crucial contribution to students' academic and developmental outcomes (Chatenoud & Odier-Guedj, 2022).

Partnerships are realized through both formal and informal arrangements. Formal collaboration includes cooperation with government institutions, such as local environmental agencies during visits to waste processing facilities, which strengthens the applying stage of deep learning through authentic, experience-based activities. Informal partnerships, such as parental involvement in reinforcing learning routines at home or providing resources for basic life-skills training, support the reflecting stage by facilitating the internalization of learned behaviors. When families encounter limitations, schools extend partnerships to internal support units, such as school kitchens, to ensure continuity of functional skill development. These findings indicate that partnerships in deep learning are not ceremonial in nature but are adaptive, needs-based, and directly linked to pedagogical decision-making, reinforcing their role as a foundational component of the learning design.

c. Curriculum Characteristics Responsive to Specific Needs

Based on the interview results, the findings indicate that special education has unique curriculum characteristics that shape the strategies used in implementing deep learning. Although the curriculum structure is equivalent to that of regular education levels, special education includes a Special Needs Program that must be taught at every level. The goal becomes very practical, namely functional and vocational independence after graduation, which aligns with the goal of developing "social and vocational" skills identified by Schall et al. (2012) and Westwood (2008).

This program is designed according to the characteristics and needs of each type of disability. Students with visual impairments, for example, follow the Orientation, Mobility, Social, and Communication Development Program. Students with hearing impairments participate in the Auditory Perception and Rhythm Development Program, while students with intellectual disabilities follow the Self-Development Program. For students with autism, learning focuses on developing social interaction, communication, and behavior management skills. Furthermore, at the junior and senior high school levels, vocational skills are included with a larger instructional portion, especially at the senior high school level. These vocational activities are prepared to support students' independence after graduation. This curriculum structure makes deep learning not only academically oriented but also directed toward fulfilling functional and vocational needs relevant to students' daily lives.

d. Policy in Inclusive Education

The findings also reveal that the implementation of deep learning is closely related to inclusive education policies. Deep learning is understood as an instructional strategy, whereas inclusive education is a philosophy that governs the acceptance and management of student diversity. Schools that accept children with special needs must be ready to adapt their instructional strategies, learning environments, and support systems.

The government has provided various forms of training for regular school teachers to enhance their competence in facilitating students with disabilities. Since 2020, training for Special Education Support Teachers has been conducted, which later developed into tiered inclusive education training with basic, intermediate, and advanced levels offered through the Ruang GTK platform.

Additionally, the government encourages the adoption of Universal Design for Learning as a framework to ensure equitable access to education for all learners (Meyer et al, 2014). Despite these efforts, the interview results indicate that the implementation of inclusive education in regular schools is still developing. Some schools still focus only on keeping students with special needs "calm in the classroom" without providing appropriate learning services. Therefore, a deeper understanding of inclusive education philosophy is needed to ensure that deep learning can be implemented meaningfully.

e. Technology Integration in Special Education with a Deep Learning Approach

In the context of the digital era, the findings of this study provide a realistic picture aligned with the Universal Design for Learning (UDL) framework. The utilization of technology found is selective and adaptive according to students' abilities, ranging from simple assistive technologies like "pencil grips" to "interactive digital learning media." This aptly reflects the UDL principle of providing variety in methods of representation, engagement, and expression (CAST, 2024; Kelly et al., 2022; Meyer et al., 2014). The finding that AI is currently used more by teachers for designing learning, rather than being applied directly to students, aligns with the literature on adaptive technology (Chahal et al., 2024; Şanal, 2023) which emphasizes adapting technology to student needs and readiness, not the other way around.

However, limited facilities and infrastructure pose challenges, as technology use often depends on teachers' personal devices such as laptops, tablets, or mobile phones. Physical limitations of the classroom are also a consideration. This reflects the challenges highlighted by Salvia et al. (2017) regarding the lack of accessible digital media. Artificial intelligence has not been used directly by students but is utilized by teachers to design lesson materials, find references, and develop appropriate learning

activities. If AI-based technologies are used by students in the future, adult guidance will be necessary to ensure proper understanding and safe device use.

f. The Importance of Initial Assessment in Special Education

One of the most significant practical implications of this study is the finding that a strong initial assessment functions as the starting point of deep learning design in special education contexts. Initial assessment is not merely an administrative or diagnostic procedure; rather, it constitutes the foundational stage upon which all subsequent pedagogical decisions are built. Without a comprehensive understanding of students' strengths, needs, and learning readiness, the selection of learning projects, technological tools, vocational pathways, and partnership models risks becoming misaligned and ineffective.

The findings reveal that teachers must gather holistic and detailed data on students' cognitive, social, emotional, and functional profiles before designing instruction. Such data directly inform critical learning design choices, including the type of project-based activities implemented, the degree of task complexity, the form of technological support provided, and the nature of family and community involvement. This aligns with previous research highlighting that initial assessments—such as learner readiness inventories and class profiling conducted at the beginning of the academic year—are essential because they provide the empirical basis for adaptive instructional planning (Abellana et al., 2025).

Furthermore, a strong initial assessment ensures that deep learning originates from students' authentic needs rather than from predetermined curricular expectations. When assessment data are used as the foundation, teachers can intentionally design deep learning frameworks that integrate adaptive pedagogical strategies, meaningful functional partnerships, contextual learning environments, and technology aligned with students' abilities. In this sense, initial assessment operates as the **anchor of inclusive deep learning**, ensuring that instructional practices remain responsive, purposeful, and capable of supporting students' functional and vocational development in real-life contexts.

4. CONCLUSION

Based on all the analyses conducted, this study concludes that the implementation of deep learning for children with special needs in the digital age is essentially a transformative process that integrates four fundamental pillars. First, a contextual pedagogical approach through the stages of understanding-applying-reflecting, which is packaged contextually with the real lives of students. Second, a functional partnership between schools, families, and communities acts as an essential support ecosystem for creating meaningful learning experiences. Third, a responsive

curriculum with an emphasis on functional and vocational skills is the foundation for preparing students for independence. Fourth, selective and adaptive technology integration, supported by substantive inclusive policies, enables personalized learning.

The findings confirm that the success of deep learning is not determined solely by technological complexity or policy perfection, but rather by educators' depth of understanding of each student's specific needs and their ability to design authentic learning experiences that are relevant to the students' life contexts. The practical implications of this study emphasize the need for various interventions from multiple angles, ranging from teacher competency development, the provision and development of technology relevant to needs, and the formulation of policies that encourage inclusive education and student equality.

This study has clear limitations. These insights were obtained from a single case study. The successful perspectives and strategies of these participants may not be generalizable to the context of new teachers or regular schools that are still struggling to understand the philosophy of inclusion. Therefore, future research needs to explore the implementation of deep learning in inclusive schools that are still in the developing stage. In addition, research and development (R&D) is urgently needed to create user-friendly and accessible “adaptive technology” and “digital teaching materials” to address the challenge of “limited inclusive interactive learning facilities” in the digital age.

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Multisectoral Collaboration in Curriculum Implementation in Remote Schools of Eastern Indonesia

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ABSTRACT

Multisector collaboration in curriculum implementation in remote schools in Eastern Indonesia is essential for addressing various educational challenges, including limited infrastructure, low teaching quality, and restricted access to educational services. This study aims to examine collaborative practices in remote schools, particularly in Papua and Maluku, involving local communities, religious leaders, traditional leaders, parents, and government authorities. In addition, the study seeks to analyze the opportunities and challenges within multisector collaboration to strengthen curriculum implementation in remote educational contexts. Using a qualitative descriptive approach through literature reviews, case studies, and in-depth interviews with teachers, this research found that the involvement of multiple stakeholders has a positive impact on the development of more relevant and context-responsive curricula. Such collaboration enriches the learning experience by integrating local cultural values and real-life community contexts. Consequently, this collaborative approach produces curricula that are more responsive to local needs and contributes to the realization of more inclusive and equitable education in remote regions.

Keywords: *curriculum implementation; Eastern Indonesia; multisectoral collaboration; education, remote schools*

1. INTRODUCTION

Equal access to education is a goal cherished by every citizen, as equitable educational opportunities are believed to foster a more just and prosperous society. As a primary means of human resource development, quality education significantly contributes to poverty alleviation, increased social mobility, and long-term economic development (Cahyono, 2024).

Quality education plays a crucial role in equipping individuals with the skills and knowledge needed to effectively participate in a competitive modern economy (Judijanto & Shodiqin, 2025). In the context of Indonesia, the educational gap between urban and rural areas, as well as disparities between provinces, remain significant challenges that require a comprehensive approach (Safitri, 2022). It seems that the remote and underdeveloped regions in Eastern Indonesia face numerous challenges in improving the quality of education.

Underdeveloped regions often face various challenges such as limited infrastructure, a shortage of qualified teachers, low accessibility, and insufficient educational facilities and infrastructure (Evershine et al., 2024). Children in Eastern

Indonesia tend to have higher dropout rates and lower school retention, coupled with a lack of quality teaching due to poorly trained teachers, minimal support facilities, and limited access to the internet or digital learning resources, particularly in remote areas and small islands (Saifullah & Yawan, 2022; Sidauruk et al, 2025). In Papua, for example, studies show that investments in human capital through education such as average years of schooling (RLS), expected years of schooling (HLS), and life expectancy (AHH) have a positive impact on the Human Development Index (HDI). However, operational achievements on the ground appear to be suboptimal due to infrastructure constraints, budget limitations, and high dropout rates (Oktania et al., 2024).

Given the complexity of the challenges faced by underdeveloped regions, efforts to improve the quality of education cannot be separated from the role of the curriculum as the foundational basis for the implementation of learning. The limitations in infrastructure, the low availability of qualified teachers, and the minimal access to learning resources highlight the need for a curriculum that is not only relevant but also adaptive to the social, geographical, and cultural conditions on the ground. In other words, improving the quality of education in these regions must start with strengthening the curriculum as a strategic reference that can bridge gaps and guide the learning process toward more meaningful outcomes (Azkiyah, Aryola, & Lukitoaji, 2025; Farhatin, 2025).

The curriculum functions as an operational framework that determines the design of learning, learning objectives, and assessment tools for measuring student competency achievement. Several studies in the Indonesian context suggest that curriculum innovations, such as curriculum structure simplification and the implementation of an outcome-based education approach, are seen as the main foundation for guiding changes in teaching practices and efforts to improve the national education quality (Anih *et al*., 2021; Mufanti *et al*., 2024). The curriculum holds a key position in education, as it is related to the direction, content, and process of education, which ultimately determines the type and qualifications of graduates from an educational institution (Dhani, 2020).

Rahman et al. (2021) state that teacher participation in the curriculum development process plays a significant role in enhancing its effectiveness. The curriculum can be developed by involving various sectors as sources of input, ensuring that the competencies and knowledge taught are more aligned with industry needs and social dynamics. The implementation of project-based learning or real-world work experience can also be integrated, providing students with opportunities to develop practical skills relevant to the workforce context. This approach not only contributes to the improvement of technical competencies but also strengthens students' critical thinking, collaboration, and adaptability (Khalid & Owusu-Boateng, 2024). By

incorporating diverse perspectives, the curriculum can be designed to address current challenges while preparing students for the future (Ruhushandy et al., 2024).

Furthermore, this participatory process aligns with the direction of the national education transformation, which emphasizes the importance of flexibility, local relevance, and lifelong learning (Wahyuni & Susanto, 2023). Thus, curriculum development is no longer viewed as an exclusive domain of the central government but as an open dialogue arena between various stakeholders. As stated by Hasanah (2023), "The active participation of stakeholders is the spirit of an inclusive and equitable curriculum development process." Therefore, teachers play a strategic role in bridging these various perspectives into the learning process to ensure that the curriculum is truly alive and functional.

In the context of Indonesia, where disparities between regions and local needs are highly diverse, a structured multisector approach can help ensure that the curriculum is contextual and inclusive. For example, by involving local governments, local industry players, and community leaders in the phase of validating local competency needs before the finalization of the curriculum (Cahyono, 2024). This collaboration is expected to support curriculum development, ensuring that existing limitations do not become obstacles to achieving learning objectives.

However, a more critical issue lies not only in the design of the curriculum but also in the implementation phase at the education unit level. In many remote schools in Eastern Indonesia, teachers face a significant gap between the demands of the curriculum and the actual conditions on the ground. Research by Saiman et al. (2025) indicates that the achievement of the Merdeka Curriculum in South Taliabu District has not been optimal due to limited supporting facilities, and many teachers feel unprepared due to the lack of training and technical assistance. This condition shows that a curriculum document alone is not sufficient without systemic support from various stakeholders; without this, implementation tends to be hindered.

In the context of implementation, multisectoral collaboration becomes a key component in bridging the existing limitations. Cooperation between local governments, the private sector, and local communities has proven to help overcome geographical barriers and limitations in educational resources, improve school infrastructure, enhance teacher capacity through continuous training, and integrate local knowledge into the curriculum to make it more relevant to the needs of students. Such collaboration reinforces the idea that multisectoral involvement is a crucial foundation for the successful implementation of curricula in areas with limitations (Enus *et al*., 2025; Hakim & Alfitri, 2025). This collaboration not only provides additional resources but also ensures that the curriculum is translated into learning practices that are in line with the local social and cultural context.

Several previous studies have primarily focused on curriculum development in urban schools or at the national level, thus making significant contributions to the general understanding of curriculum implementation. However, studies that specifically address the context of remote areas in Eastern Indonesia, such as Maluku and Papua, are still very limited. The social and cultural characteristics, as well as the limitations in educational infrastructure in these regions, present dynamics that are different from those in urban contexts. Furthermore, there is a lack of research that systematically analyzes the impact of multisectoral collaboration in curriculum implementation in remote areas. This gap in the literature highlights the need for further exploration. It is hoped that such collaboration will support the implementation of the curriculum so that existing limitations do not become obstacles to achieving learning objectives.

Based on the urgency outlined, this article aims to comprehensively examine the importance of establishing effective collaboration between teachers and various stakeholders in the curriculum implementation process. This study focuses on analyzing the implementation of collaboration that has been carried out in remote schools in Eastern Indonesia, by examining the challenges that arise in practice and identifying opportunities that can be strengthened. Through this analysis, it is hoped that a deeper understanding of the appropriate strategies to overcome existing barriers can be gained, ensuring that the collaborative process can proceed optimally and sustainably.

2. METHODOLOGY

3.1. Research Design

This study employed a descriptive qualitative approach using a literature review and a case study. The approach was chosen to gain an in-depth understanding of multisector collaboration practices in curriculum development in remote schools in Eastern Indonesia. Qualitative research enables holistic exploration of social phenomena within real-life contexts (Denzin & Lincoln, 2018).

The case study method was applied to examine collaborative practices in three remote schools in the Maluku and Papua regions, particularly where the boundaries between the phenomenon and its context are unclear (Yin, 2018). Through this approach, the researcher can obtain a comprehensive theoretical and empirical understanding of multisector collaboration in remote schools.

3.2. Participants of the Study

The participants consisted of three teachers from remote schools in Maluku and Papua, selected through purposive sampling. This technique was used because the participants had direct involvement in multisector collaboration activities relevant to the research focus. The limited number of participants aligns with qualitative research

principles that emphasize depth of understanding rather than sample size (Creswell & Poth, 2018).

3.3. Instruments

Data were collected through semi-structured in-depth interviews and analysis of informal documents. Interviews were conducted online to explore participants' experiences and perspectives in depth while maintaining flexibility (Silverman, 2020). Informal documents, such as teaching notes, photos, and videos, were analyzed to support and triangulate interview data, particularly given the limited availability of formal documents in remote school contexts (Bowen, 2009).

3.4. Data Analysis Techniques

Data were analyzed using thematic analysis following Miles, Huberman, and Saldaña's (2014) model, which includes data reduction, data display, and conclusion drawing. Source triangulation between interview data and informal documents was employed to ensure the credibility and validity of the findings.

3. RESULT AND DISCUSSION

Below is the triangulation table that illustrates the data sources used in this study:

Table 1. Triangulation Data Sources

Type of Triangulation	**Teacher 1** (Papua, coastal area)	**Teacher 2** (Maluku, mountainous area)	**Teacher 3** (Papua, swamp area)
Interview	Collaboration with the community in entrepreneurship classes.	Collaboration with the community, religious leaders, government, and parents.	Collaboration with communities across professions and communities as guest teachers
Informal Documents	Not available	Teaching agenda notes, discussions with parents	Teaching agenda notes and inspirational videos
Photos and Videos	Implementation documentation	Implementation documentation	Implementation documentation
Source triangulation	Implementation documentation	Implementation documentation	Implementation documentation
Triangulation method	Interviews and photos/videos	Interviews, informal documents and photos/videos	Interviews, informal documents and photos/videos

This triangulation shows that data validation is carried out by combining various sources of information and methods. Data obtained from interviews are combined with visual documentation evidence (photos/videos), as well as informal notes from teaching agendas and discussions with parents or community leaders.

On the other hand, although formal documents such as lesson plans (RPP) or written teaching agendas were not available for Teacher 1, the information obtained through interviews and photo/video documentation still provides a clear picture of the collaboration taking place in these remote schools. This indicates that informal documents and visual evidence can serve as a valid alternative in exploring educational practices in the field, especially in remote areas.

For Teacher 2 and Teacher 3, the presence of informal documents and photo/video evidence further supports the validation of information obtained from interviews, showing that the implementation of collaboration in their schools was not only discussed verbally but also recorded in a form that is more accessible and understandable to researchers and relevant stakeholders.

These teachers did not solely rely on traditional teaching methods, but also encouraged community involvement in the teaching and learning process. This approach provides students with direct insights into the real world around them and opens up opportunities for them to engage in beneficial activities, such as entrepreneurship classes or project-based learning.

The implementation of multisectoral collaboration carried out by teachers at schools

The results of the interview with Teacher 1, who teaches in the remote areas of Papua Province with characteristics of schools located along the coast, showed that several multisectoral collaborations have been conducted in the curriculum development, including:

Collaboration between teachers and the community. The form of collaboration between teachers and the community is evident in the development of an entrepreneurship class. In this class, the teacher created an entrepreneurial activity by processing natural resources, specifically coconuts, into cooking oil, which is then sold. The proceeds from the sales are used to purchase stationery and school supplies for the students. The community, particularly the parents, is involved in the production and marketing process. Indirectly, the community is engaged as a collaborative partner in this initiative.

Collaboration between teachers and cultural leaders. The form of collaboration that took place was when the teacher invited the children to observe and recognize traditional musical instruments found around them. The teacher took the children to the house of a cultural leader who owned many traditional musical instruments and asked the cultural leader to explain to the children about the various instruments.

This was revealed in the interview with Teacher 2, who teaches at a primary school in the mountainous area of Maluku.

Collaboration between teachers and the community. The form of collaboration between the teacher and the community that can be seen is the involvement of the

community in the learning process as partners in education. The teacher developed a Project-Based Learning (PjBL) approach with the topic of Utilization of Natural Resources. The teacher guided the students to identify the abundant natural resources around them. The results of the identification were then compiled into a list of potential natural resources, from which they chose what to process. The students decided to process the abundant taro found around them into chips and market them. The community was involved as a collaboration partner in this Project-Based Learning initiative.

Collaboration between teachers, religious leaders, and community leaders. This form of collaboration is established through the "Friday Character Building Program," where Teacher 2 invites religious leaders (pastors) and community leaders (village heads) to attend the school every Friday in turn to provide character reinforcement through joint worship and mentoring for the students.

Collaboration between teachers and the government. The collaboration between teachers and the community can be seen in the training sessions for curriculum implementation organized by the education office or the learning communities formed by teachers at the district level. Several training sessions attended include the implementation of the Merdeka Curriculum and the introduction of the GASING method in teaching mathematics in the classroom.

Collaboration between teachers and parents. The form of collaboration seen between teachers and parents is through discussions held to gather parents' opinions regarding the values needed to improve students' character development. Parents provide input, and teachers follow up by incorporating these suggestions into the development of the learning process conducted at school.

The interview results with Teacher 3, who teaches in the remote areas of Papua Province with characteristics of a school located in a swamp region, indicate that several multisectoral collaborations have been carried out in curriculum development.

Collaboration between teachers and the community. The form of collaboration implemented involves inviting community members as guest teachers to teach the local language to students at the school. Additionally, community members from various professions are encouraged to participate in creating inspirational letters and educational videos, aimed at providing motivation, character values, and real-world perspectives for the students at the school.

Based on interviews with three teachers who teach in remote schools in the Papua and Maluku regions, several forms of multisectoral collaboration have been implemented in the development of the curriculum. These collaborations involve various stakeholders, including the community, traditional leaders, religious leaders, parents, and the government. The following is a discussion of the forms of collaboration that have been carried out:

1. Collaboration with the Local Community

Collaboration between teachers and the local community is one form of curriculum development that can enhance the relevance and quality of education in remote areas. Based on the interview with Teacher 1 in Papua, it was found that the collaboration carried out was the development of an entrepreneurship class involving the local community as partners. In this case, the community played a role in the production and marketing of products, such as cooking oil made from processed coconuts. This finding shows that the community is not only a supporter of school activities but also a collaborative partner in the curriculum development process. Through the active involvement of the community, the learning process becomes more contextual and relevant to the students' lives. This aligns with the research by Mu'ammaroh et al. (2024), which emphasizes that community-school collaboration is a strategic approach in community-based education management, as it allows for the integration of local needs into the learning process at school.

Meanwhile, Teacher 2 in Maluku also developed collaboration through the implementation of Project-Based Learning (PjBL). In this project, the teacher collaborates with the local community to identify natural resources that can be processed into products, such as taro chips. The community is involved in the production and marketing processes, allowing students to learn directly from hands-on experience in the field. This collaboration strengthens contextual learning, where the content taught is not only theoretical but also directly connected to the local community's life. This community-based learning facilitates students in developing skills that align with the needs of their region, while also fostering a sense of ownership toward the local environment and economy. The involvement of the community in PjBL strengthens the concept of Education for Sustainable Development, which emphasizes the importance of empowering local communities as part of the educational process (UNESCO, 2022).

Based on the interview results with Teacher 3, one form of multisector collaboration implemented is inviting members of the community from various professions to participate in the creation of inspirational letters and educational videos aimed at providing motivation, character values, and real-world perspectives for students in the school. Such collaboration reflects the involvement of various sectors in efforts to provide a more contextual and relevant education, particularly in schools located in remote areas (Hariani, 2023; Solikhah, 2021). Community members from various professions, as mentioned in the interview with Teacher 3, include individuals from diverse professional backgrounds such as entrepreneurs, healthcare workers, community leaders, and other professionals. Their involvement in creating inspirational letters and educational videos creates synergy between formal education and the practical experiences and knowledge possessed by these community members.

The inspirational letters created by members of the community from various professions serve to motivate students. These letters can contain positive messages that inspire students to be more enthusiastic about learning, as well as provide real-world perspectives on various professions that may not be familiar to students in remote areas. Their involvement in creating inspirational letters and educational videos creates synergy between formal learning and the contextual knowledge of the community, thus enriching the learning resources and broadening the students' career horizons (Listrianti, 2024; Pradana, 2025).

Students in remote areas are often less exposed to various career options and the professional world. By involving professionals from diverse sectors, this collaboration provides students with a clearer view of the outside world and inspires them to pursue their dreams. Inspirational letters from professionals can resonate deeply with students, building motivation and hope for their future. This is an effective tool for introducing career options to isolated students (Oshiro, Beecroft, & Hunter, 2023; Waslowski & Sadowski, 2021). Such exposure helps students understand how school skills connect with the real world, enhances the relevance of learning, and fosters career aspirations (Wijaya, 2022).

In addition to its informative function, the letters and videos created with the involvement of professionals from various sectors also serve as tools for character education. The real-life stories shared by professionals highlight the application of values such as work ethics, responsibility, teamwork, and leadership values that are crucial for the affective development of students (Barokah, Yuliana, & Raharja, 2025; Sugiono, 2017). In remote areas, where access to information and exposure to a variety of professions is often limited, this multisector collaboration broadens students' perspectives and aspirations while strengthening the relationship between schools and the community (Hariani, 2023; Listrianti, 2024).

When professionals from various sectors are involved in educational activities, they feel valued and develop a sense of belonging to the school. This aligns with the concept of community-based education, which emphasizes that education should grow from and for the community (Solikhah, 2021). This involvement also opens opportunities for the community to support the advancement of education in their own area through active participation, sharing experiences, and multisector collaboration (Pradana, 2025; Hariani, 2023).

Thus, the collaboration between teachers and the community across various professions not only enriches the curriculum through more contextual learning resources but also strengthens character education and creates space for education that is socially and culturally relevant. This approach aligns with the principles of place-based education, where learning is directly connected to the real-life experiences and social environment of the students (Sugiono, 2017; Listrianti, 2024).

2. Collaboration Between Teachers and Religious and Cultural Leaders

Collaboration between teachers and religious leaders as well as cultural figures was also found in the implementation of the curriculum focused on character development and the introduction of local culture. In the school managed by Teacher 2, collaboration with religious figures (pastors) and community leaders (village heads) took place through the "Friday Character Building" program, where every Friday, they provide character reinforcement to students through joint worship and moral guidance. This program is a concrete example of how character education can be enriched with contributions from religious and community leaders, who hold significant influence over students in the area.

In addition, Teacher 1 also involves students in collaborating with cultural leaders to learn about traditional musical instruments. This activity not only introduces cultural values but also familiarizes students with their local identity, enriching their learning experience. Collaboration with cultural and religious leaders has a significant impact on character education. The values shared by religious and cultural leaders enhance the social and cultural dimensions of learning, fostering a sense of pride in local identity among students.

4. Collaboration Between Teachers and Government

The collaboration between teachers and the government in curriculum development is reflected in training programs organized by the education department and learning communities at the district level. Teacher 2 shared that they participated in training sessions on the implementation of the Merdeka Curriculum and the introduction of the GASING method in mathematics teaching. These training programs not only provided teachers with insights into more effective teaching methods but also offered an opportunity to engage in discussions with other teachers about the implementation of curricula that better align with local conditions.

Collaboration with the government can also provide support in the form of teaching materials relevant to the local context, as seen in the training for curriculum implementation attended by Teacher 2. Such training is part of the government's efforts to enhance teachers' readiness for the implementation of the Merdeka Curriculum. Literature indicates that teachers' preparedness remains a major challenge in curriculum reform in Indonesia (Al Arsyadhi, Dewi, & Hernawan, 2024), highlighting the importance of collaboration through training initiatives like this.

5. Collaboration Between Teachers and Parents

Collaboration with parents has also proven to be effective in improving the quality of education in remote areas. In the interview with Teacher 2, it was evident that discussions took place between the teacher and parents regarding the values needed

to enhance students' character. Parents provided input that was then used for the development of learning in school. This collaboration is crucial because parents possess valuable insights into their children's needs, which can be integrated into the learning process.

Furthermore, this collaboration is not limited to academic aspects but also extends to the development of students' character, as evidenced by research revealing that parental involvement in home-based educational activities has a strong positive impact on children's character development (Paul et al., 2022, p. 341). Kristanti et al. (2024) also emphasize that school-parent partnerships are essential in shaping children's character, which in turn supports their academic and social success.

Challenges and Opportunities in Multisector Collaboration

Multisector collaboration in education, particularly in remote areas, holds significant potential to enhance the quality of learning and the relevance of the curriculum. However, there are also various challenges that need to be addressed to ensure the expected outcomes are achieved effectively and sustainably. Through interviews and observations of three teachers in remote schools in Eastern Indonesia, this study identified several key challenges that arise in efforts to establish multisector collaboration to support the implementation of the curriculum.

Firstly, the limitation of Human Resources and Infrastructure. The lack of skilled human resources (HR) and adequate infrastructure is one of the main challenges in multisector collaboration in remote areas. The scarcity of trained teachers and limited educational facilities are common in remote areas of Eastern Indonesia, leading to multisector collaboration relying on only one or two teachers. The limitations of infrastructure also hinder teachers from participating in training and mentoring programs for curriculum implementation organized by the government. Limited road and transportation infrastructure further obstructs access for both students and teachers to education locations, resulting in inequitable learning opportunities (Purwa & Cendekia, 2022).

Secondly, the availability of resources and support from various stakeholders is a crucial aspect of multisectoral education, which requires strong collaboration between the government, schools, and communities. However, in underdeveloped areas, coordination and synergy among these sectors are still far from optimal.

Despite the challenges faced, there are several opportunities that can be maximized to strengthen multisectoral collaboration practices in curriculum implementation in underserved regions. First, collaboration between the community, government, and schools can be reinforced to support curriculum implementation at schools. The government can provide training for teachers regarding curriculum implementation, and the community can be engaged as partners in the learning process.

Secondly, the utilization of local potential and wisdom in the curriculum can lead to a more contextual and meaningful educational process for students. When elements of local culture and language are integrated into the learning process, students tend to feel more connected to the material being taught. Furthermore, strengthening vocational education that focuses on practical skills relevant to the local community can equip students with competencies that can be directly applied in their daily activities within their environment (Tartakower, 2024).

Thirdly, multisectoral collaboration in curriculum implementation plays a crucial role in raising community awareness of the strategic value of education. When schools open their doors to partner with parents, community leaders, and other local institutions, education is no longer seen as solely the internal responsibility of the school, but rather as a shared responsibility. Through such partnerships, parents and community members are involved in decision-making processes, the implementation of learning activities, and the assessment of educational needs in their environment. This active participation from the community helps build a sense of ownership, while also strengthening the community's commitment to supporting school programs, such as providing resources, moral support, and technical assistance. In this context, the collaboration between teachers, parents, and the community systematically builds a shared awareness that education is a long-term investment that involves all aspects of social life (Ni'mah, Purbasari, & Setiawaty, 2023). Thus, multisectoral collaboration not only strengthens the operational structure of the curriculum but also transforms the community's perception of education as an integral part of local social and economic development.

4. CONCLUSION

Based on the findings presented earlier, it can be concluded that the collaboration between teachers, local communities, traditional leaders, religious leaders, parents, and the government has had a significant impact on the development of a curriculum that is more contextual and relevant to local needs. This collaboration takes various forms, such as the development of entrepreneurship classes, project-based learning (PjBL), and character-building programs involving religious and community leaders.

Collaboration with the local community, as seen with Teacher 1 developing an entrepreneurship class and Teacher 2 implementing PjBL by utilizing local natural resources, enriches students' learning experiences. The community plays an active role in the production and marketing of products, such as cooking oil and taro chips, which also provide direct economic benefits to students and the community. Collaboration with professionals from various fields, as practiced by Teacher 3 through the creation of inspirational letters and educational videos, offers real-world perspectives to

students, while also introducing important character values that contribute to their personal development.

The importance of the role of religious and traditional leaders in shaping students' character is also highlighted in this study. The "Jumat Bina Karakter" program, which involves the pastor and village head, contributes to strengthening moral and social values among students. Additionally, collaboration with the government through curriculum training and new teaching methods provides significant support in improving the quality of education in remote areas.

However, despite the great potential of multisectoral collaboration, challenges such as limited human resources, poor infrastructure, and a lack of coordination between sectors remain barriers to its implementation. Limited infrastructure and accessibility to education in remote areas are still issues that need to be addressed to improve the effectiveness of this collaboration.

Based on these findings, several recommendations can be made to strengthen multisectoral collaboration in education, particularly in remote areas. First, it is recommended that the government strengthen training programs for teachers regarding the implementation of the curriculum and the latest teaching methods, as well as improve educational infrastructure in remote areas, especially in terms of transportation access and technology to enable more effective teaching. Second, schools and teachers are advised to continue fostering collaboration with local communities, traditional leaders, and religious leaders to enrich the curriculum with relevant local values and to develop more contextual and applicable community-based learning. Third, parents and the community should be more involved in the educational process, not only in academic monitoring but also in character development and the development of practical skills relevant to local needs.

Furthermore, strengthening vocational education that focuses on practical skills according to local community needs should be a priority, in order to equip students with competencies that can be directly applied in everyday life. By maximizing the potential of local wisdom and involving all stakeholders in the educational process, it is hoped that a more relevant, sustainable, and beneficial education can be created, contributing to the development of communities in remote areas.

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A Qualitative Portrait of Learning Evaluation Implementation at SDN 195 Isola Bandung

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ABSTRACT

Learning evaluation served as a crucial component in measuring learning objectives achievement, yet field practices revealed variations in implementing comprehensive evaluation instruments and methods. This study reveals a unique characteristic in SDN 195 Isola's evaluation system: the integration of formative and summative approaches with structured parent involvement mechanisms, which differs from conventional elementary school practices in Indonesia. The study employed a descriptive qualitative method with data collection techniques consisting of interviews with the grade VI homeroom teacher, observations of 25 grade VI students, and review of learning documents. Sample was determined through purposive sampling with instruments in the form of observation guides and interview guides. Results showed that the school implemented evaluations across cognitive, affective, and psychomotor domains. In the cognitive domain, post-tests and individual assignments were the most frequently used methods to measure student understanding. The affective domain was assessed through observations by homeroom teachers and student affairs teachers, as well as self-assessment and peer assessment. The psychomotor domain was assessed through practice, projects, and product creation. The main findings of this study revealed two important points: first, the school had implemented various assessment techniques that reflected a holistic approach; second, there remained inconsistency in the use of instruments, especially in the affective and psychomotor domains, thus requiring an increase in assessment literacy for teachers. This diverse evaluation approach supported learning decision-making and helped teachers understand student development more comprehensively.

Keywords: *Assessment, Learning Evaluation, Observation Research*

1. INTRODUCTION

Quality education requires that every student be given the opportunity to develop their abilities to the fullest. Article 11 Paragraph 1 of Law Number 20 of 2003 on the National Education System emphasizes the government's obligation to guarantee quality education for all citizens. The quality of education is reflected in the development of students' abilities, which needs to be monitored through systematic learning evaluations to observe the process, progress, and improvement of learning outcomes. Evaluation plays an important role in learning. Evaluation is an assessment process to measure student growth and determine grades in the learning process (Suardipa and Primayana, 2020; Zamzania and Aristia, 2018). Teachers need evaluation to assess student learning outcomes and review the success of the material delivered

in class. Assessment serves as the basis for learning decision-making (Chairawati, 2014).

The implementation of ideal evaluation requires clear references, appropriate techniques, and valid and reliable instruments. Evaluation must be carried out in a structured and continuous manner to understand student development in cognitive, affective, and psychomotor aspects (Elis and Rusdiana, 2015). Teachers need to process and analyze evaluation results appropriately to ensure accurate interpretation. Various problems in learning evaluation still occur in schools. Misunderstandings about assessment cause the implementation of evaluation to not run optimally. Various studies show that teachers fail to conduct evaluations (Riadi, 2017), use numbers as the only indicator of learning success (Ismail, 2015), and manipulate grades to the detriment of students (Magdalena, et al., 2020). Evaluation is also often understood as merely assessing the completion of questions, whereas evaluation covers many factors that influence learning.

Time constraints also affect the implementation of evaluation. Some teachers avoid evaluation because they focus on delivering the full material in one meeting. This practice reduces the opportunity to measure learning outcomes comprehensively (Zuhera, et al., 2017). Irregular evaluation that only focuses on cognitive aspects makes it difficult to achieve learning objectives (Rosyad, 2020). Teachers also experience obstacles in developing process assessment instruments (Asarina, 2014). These various issues indicate the need to review the implementation of learning evaluation in schools.

Based on these issues, this study was conducted to examine the implementation of learning evaluation at SD Negeri 195 Isola Bandung. Observations and interviews were conducted to determine how teachers carry out evaluations in the cognitive, affective, and psychomotor domains. This study describes the evaluation practices that take place in the classroom, the techniques used by teachers, and the instruments used. Understanding this process can help schools identify the improvements needed to make learning evaluation more systematic and in line with the characteristics of ideal assessment.

Most studies on learning evaluation in elementary schools focus primarily on cognitive assessment techniques, while limited attention has been given to the integration of formative and summative assessment combined with systematic parental involvement. Therefore, this study addresses this gap by examining the learning evaluation practices implemented at SDN 195 Isola Bandung. This study provides an overview of the application of evaluation in three areas of assessment and identifies the supporting factors and obstacles faced by teachers in its implementation. SDN 195 Isola Bandung was selected due to its distinctive approach in balancing three assessment domains despite resource constraints typical of public elementary schools.

2. METHODOLOGY

This study applied a descriptive qualitative approach aimed at portraying the actual implementation of learning evaluation in Grade VI at SDN 195 Isola Bandung. The approach was suitable for capturing natural assessment practices, documenting teacher decision-making processes, and observing how students respond to various evaluation methods.

A pre-observation stage was conducted to identify existing issues at the site, revealing irregularities in assessment procedures, variations in teachers' use of instruments, and students' limited understanding of the purpose of evaluation. These initial findings guided the selection of participants, refinement of instruments, and focus of inquiry.

3.1. Participants of the Study

The sampling technique, purposive sampling, was applied specifically to (1) the teacher responsible for the evaluation system and (2) the Grade VI class where evaluation practices were consistently implemented.

3.2. Instruments

The instruments capture teacher activities, student behaviors, and assessment procedures, therefore these aspects were integrated into the observation instrument design. Included planning of learning evaluation, development of assessment instruments, teacher rationale for selected assessment methods, challenges in implementing cognitive, affective, psychomotor assessments and utilization of assessment results for instructional decision. Documentation checklist has been used to collect worksheets, test sheets, and scoring rubrics, teacher observation notes, affective assessment records and samples of students' projects or performance tasks. Content validity was established through expert review by two Educational Assessment lecturers. Reliability was strengthened through data triangulation, comparing observation data, interviews, and documents for consistency.

3.3. Data Analysis Techniques

This analytical approach allowed the researchers to construct a comprehensive portrait of learning evaluation at SDN 195 Isola Bandung. Data analysis followed Miles & Huberman's interactive model, consisting of:

1. Data Reduction by transcribing interviews, summarizing observation notes based on instrument indicators.
2. Data Display from tables summarizing cognitive, affective, and psychomotor practices and narrative descriptions of teacher and student behaviors.

3. Conclusion drawing and verification by identifying recurring themes related to evaluation practices, cross-checking findings through triangulation and Ensuring conclusions align with research objectives.

3. RESULT AND DISCUSSION

RESULT

The results of this pre-observation conducted prior to data collection revealed that teachers at the school frequently rely on varied assessment forms but face challenges in balancing cognitive, affective, and psychomotor evaluations due to time constraints and limited assessment tools. The cognitive domain, there are many instruments that are often used by schools. In terms of testing instruments, almost all are used with the aim of measuring students' ability to understand the material. The percentage of cognitive domain testing instruments can be seen in the chart below.

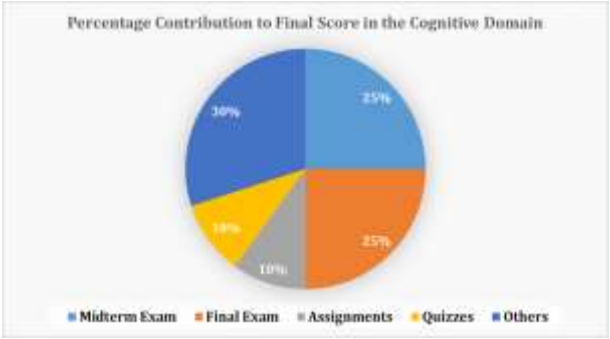

Figure 1. Percentage Contribution to Final Score in the Cognitive Domain

The most frequently used testing instruments or other non-testing instruments can be seen in the chart below.

Table 1. Cognitive Domain Assessment System

Specific Aspects	Description				
Assessment methods	Individual assignments	Post-test	Group Assignments	Practical exams or tests	Practical exam reports
Frequency of assessment methods	Frequently	Frequently	Occasionally	Occasionally	Occasionally
Test Instrument Form	Objective description	Multiple choice, Matching	Project creation, presentation	Project creation, presentation	True or false statements, Performance, Short answer
Purpose of assessment	To measure students' achievement as the final result of their learning in terms of their understanding of the material or subject matter.				

As illustrated in **Table 1** the cognitive domain in which many instruments are often used by schools. In addition, almost all test instruments are used with the aim of measuring students' ability to understand the material.

Table 2. Affective Domain Assessment System

Assessment methods	Observation by homeroom teachers	Observation by guidance counselors	Peer assessment	Self assessment
Frequency of assessment methods	Frequently	Occasionally	Rarely	Self-assessment
Form of assessment instrument	Observation sheet	Others (recorded directly without any specific format)		
The purpose of this assessment	Measuring students' achievement as the final result of their learning in terms of their understanding of the material or subject matter. How to design questions and understand student characteristics to produce effective learning.			

The assessment system in the affective domain, as illustrated in **Table 2** and utilised by the educational institution, involves frequent observation by teaching staff, with homeroom teachers conducting the highest number of observations. A variety of instruments are employed, with paper being the most prevalent, and observations are recorded directly without any specific format. Teachers utilize affective domain assessments to measure students' achievement as the final outcome of learning, in addition to gaining insight into the students' characters.

Table 3. Psychomotor Domain Assessment System

Assessment methods	Practicing procedures/processes	Handicraft Products	Group Projects
Frequency of assessment methods	Occasionally	Occasionally	Occasionally
Form of assessment instrument	Written and oral instruments in the form of files		
The purpose of this assessment	The objective of this study is to assess the students' proficiency in applying the material that has been taught.		

As illustrated in **Table 3**, the psychomotor domain assessment system employs a methodology that necessitates students to move around while developing material. However, it should be noted that this method is employed exclusively in specific lessons that necessitate student participation in practical exercises. The assessment is conducted using written or oral instruments in the form of files. The purpose of psychomotor domain assessment is to enable teachers to measure their students' ability to understand material using practical methods.

Table 4. Follow-up on Learning Evaluation

Aspects	Things to Consider
Use of Evaluation Results	Evaluation results are used to make learning decisions. At this elementary school, teachers analyze and evaluate so that students can enjoy and understand the material presented by the subject teacher.
	Evaluation results are used not only to identify and acknowledge student achievement but also to identify areas that still need improvement.
	Evaluation results are used to adapt teaching methods and personalize learning because evaluations are conducted so that educators can find the right teaching methods to deliver material to students.
Student Participation	Students are involved in the learning evaluation process. They are given the opportunity to provide feedback or evaluate themselves. This allows students to think critically and demonstrate their abilities, as the current curriculum is an independent learning curriculum.
Student Responses to Learning Evaluation Results	Student responses to learning evaluation results have not yet reached the point where they view it as a useful tool for improving the quality of learning; students are still very concerned about grades. In this regard, students only see the numbers and not the learning process itself.
Parental Involvement	Parental involvement in the learning evaluation process can be seen from the involvement of parents in their children's learning evaluation, which is only done by a few parents who ask about their children's progress at school and in class, usually class president parents who are very attentive or monitor students in class.
	Parents receive sufficient information about their children's progress. As mentioned in the previous answer, only a few parents ask about their children's development. This is done by using data presented by the homeroom teacher and given to a parent representative.

As illustrated in **Table 4**, the majority of follow-up actions implemented by educational institutions pertain to teachers, students, and parents. A plethora of evaluations are conducted, encompassing both internal and external assessments, in addition to those facilitated by relevant teaching professionals. Parents are profoundly engaged in their children's academic, social, and emotional development within the school environment. The rationale behind this is to empower parents to oversee their children's activities while they are not in proximity.

DISCUSSION

The findings indicate that SDN 195 Isola Bandung applies not only a combination of formative and summative assessments, but also involves parents as part of the learning evaluation process. This approach contrasts with common elementary school evaluation practices that are largely teacher centered and focused on final scores. There are several assessment systems used by SD Negeri 195 Isola Bandung, which are divided into two types of assessments, including: (1) Formative, an assessment aimed at providing information or feedback to educators and students to improve the learning process. (2) Summative assessment, which is conducted to ensure the overall achievement of learning objectives. This assessment is carried out at the end of the learning process or can also be conducted simultaneously for two or more learning objectives, in accordance with the considerations of educators and education unit policies (Anggraena, et al. 2022).

In the Merdeka Curriculum, teachers are expected to prioritize formative assessment in order to obtain feedback and monitor student progress. However, summative assessment is also used to determine the achievement of learning objectives. Teachers can assess whether the teaching and learning process is effective in producing good and satisfactory results, or otherwise (Nuriyah, 2016). The learning evaluation portrait shows that the methods used by SD Negeri 195 Isola in learning are very diverse. The assessment methods applied are in the form of individual assignments and post-tests, which are conducted frequently. Individual assignments and post-tests are often used because both can measure knowledge in depth. Such practices align with Arikunto's (1997) assertion that post-tests function as reliable indicators of mastery and provide valuable feedback for both teachers and learners. Similarly, Hikmah (2016) notes that post-tests play an important motivational role, encouraging students to engage more actively in learning.

In addition, it is more difficult to compare students' learning outcomes because this form of assessment is more subjective. The speed of completion and success of student learning is largely determined by individual ability (Tefa, et al., 2019). However, if group assignments are rarely done, students will lose the opportunity to learn new things together with other students. Therefore, teachers need to give group assignments to students on a regular basis. This can help students develop various skills and competencies needed in everyday life.

Cognitive domain assessment uses various types of test instruments. SD Negeri 195 Isola uses instruments in the form of objective descriptions to measure students' abilities in depth. The problems with the descriptions compiled by teachers lie in the aspects of material, construction, and language (Saputra and Nuryadi, 2016). In addition, SD Negeri 195 Isola uses performance test instruments, which must be used objectively and consistently. In teaching and learning, process skills are required, with teachers expected to use inquiry teaching strategies (Aydinli, 2011). Therefore, it is very

important to determine the level of student performance in existing learning process skills.

The affective domain assessment used at SD Negeri 195 Isola is more focused on the supervision of guidance counselors, homeroom teachers, and subject teachers. In this case, homeroom teachers have a better understanding of the nature of students in a classroom learning environment. As educators, homeroom teachers must have extensive knowledge of the disciplines that must be taught or transferred to students (Qualeng, 2020). Thus, affective domain assessment is conducted to measure students' achievement as the final outcome of their learning in terms of their understanding of the material or subject matter. How to design questions and understand student characteristics to produce effective learning.

Psychomotor skills are an assessment of the domain related to skills or abilities to act after a person has received certain learning experiences (Febrianti, 2021). The assessment of psychomotor skills is carried out by observing the activities of students in doing something (Rahmah and Nasryah, 2019). In the psychomotor domain, there are three assessment methods used by homeroom teachers to assess their students' skills, including practicing procedures or processes. This method can encourage students' understanding of certain procedures in the subject matter being taught. The initial purpose of conducting psychomotor domain assessments is to measure students' ability to practice the material that has been taught.

Overall, these findings show that while the evaluation system at SDN 195 Isola Bandung is diverse and generally well-implemented, its effectiveness could be further enhanced by increasing the consistency of affective and psychomotor assessments, strengthening student understanding of evaluation purposes, and encouraging greater parental involvement.

4. CONCLUSION

The cognitive domain is assessed through post- tests, individual assignments, group assignments, practical exams, and practical reports. The affective domain is assessed through observations by homeroom teachers, observations by guidance counselors, peer assessments, and self-assessments. The psychomotor domain is assessed through practical activities, product creation, and group projects. Each assessment method contributes differently to the picture of student abilities and helps teachers understand their development more comprehensively.

The data shows that the implementation of learning evaluation in this school has been carried out using a broad approach and covers a variety of techniques. This practice allows teachers to view learning outcomes from various angles of student abilities. However, the study also found that the affective and psychomotor domains still require more standardized instruments to make the assessment process more

consistent and easier to interpret. Improving teachers' assessment literacy is also necessary so that the use of instruments and analysis of learning outcomes can be carried out more reliably.

The results of this study have several practical implications. Teachers can use the evaluation results to make learning decisions and provide additional support to students who need it. Students can use the evaluation results to understand their strengths and weaknesses. Parents can obtain regular information on their children's development so that they can provide appropriate guidance. This research can also be a reference for other elementary schools to develop more comprehensive evaluation practices that are in line with the characteristics of learning in Indonesia. Properly implemented learning evaluations can strengthen the quality of learning and support the development of students' abilities in various aspects. This study contributes to the field by documenting how a public elementary school successfully implements multi-domain assessment despite common constraints, offering a replicable model for similar educational contexts in Indonesia.

The novelty of this study lies in the identification of an integrated formative and summative evaluation system with parental involvement within a public elementary school context with limited resources. This finding offers a practical reference for other elementary schools seeking to develop more comprehensive and participatory learning evaluation practices.

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Transforming Authentic Assessment in Chemistry Learning Through the Collaboration of Merdeka Curriculum and AI Technology

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ABSTRACT

The study investigated the transformation of authentic assessment in education, which represented a shift from product-based evaluation toward contextual, reflective, and competency-oriented learning. Within the *Merdeka Curriculum* framework, authentic assessment functioned as both an evaluative and developmental tool to cultivate 21st century skills (critical thinking, creativity, collaboration, and communication) while supporting the *Profil Pelajar Pancasila*. However, limited research had examined how Artificial Intelligence (AI) could operationalize authentic assessment principles within this curriculum. An integrative literature review was conducted to analyze thirteen peer-reviewed journal articles published between 2023 and 2026. The inclusion criteria covered three aspects: a focus on authentic assessment in education, the integration of AI or digital technologies, and relevance to 21st-century learning competencies. The synthesis showed three major findings. First, AI enhanced experiential and reflective learning through generative tools and personalized feedback that deepened students' conceptual understanding and inquiry processes. Second, ethical and pedagogical tensions appeared between authenticity and academic integrity due to the increased use of AI in completing authentic tasks. Third, AI fostered innovative assessment models that redefined teacher roles and learner agency, enabling data-informed reflection and adaptive evaluation. The study concluded by proposing a conceptual model for integrating AI-based authentic assessment aligned with the *Merdeka Curriculum*, emphasizing ethical implementation, human-AI collaboration, and scientific literacy as essential components of transformative learning.

Keywords: *artificial intelligence, authentic assessment, Merdeka Curriculum, Profil Pelajar Pancasila.*

1. INTRODUCTION

The rapid advancement of the digital era has prompted a fundamental shift in educational assessment practices, moving away from purely summative evaluation toward more authentic and process-oriented approaches that are capable of capturing students' real competencies. In chemistry education, this shift is particularly crucial due to the dual emphasis on conceptual understanding and experimental skills, which necessitates comprehensive assessment across cognitive, affective, and psychomotor domains (Nahadi & Firman, 2019; Supardi, 2015). Authentic assessment highlights learners' ability to apply scientific knowledge in meaningful contexts that reflect real-world scientific practices, thereby providing a more holistic representation of learning outcomes (Darling-Hammond & Snyder, 2000; Wiggins, 1993).

Within the Indonesian educational context, the Merdeka Curriculum reinforces the importance of authentic assessment as a strategic instrument for nurturing the Profil Pelajar Pancasila, particularly in fostering critical thinking, creativity, collaboration, and communication skills (Sugiri & Priatmoko, 2020). In chemistry learning, these principles are commonly operationalized through project-based laboratory activities, portfolio assessments, and inquiry-oriented evaluation models that encourage active student engagement and reflective learning processes (Pahriah et al., 2025; Setyawarno & Kurniawati, 2018).

Despite its pedagogical potential, the implementation of authentic assessment in chemistry classrooms remains challenging. Previous studies report that limited teacher readiness, time constraints in designing assessment instruments, and varying levels of digital literacy among educators hinder its effective application (Devi & Fatonah, 2025; Hanifah & Irambona, 2019). Alongside these challenges, recent technological developments have introduced artificial intelligence as a promising tool to support assessment practices, particularly through automated scoring systems, adaptive feedback mechanisms, and data-driven learning analytics (Bulut & Beiting-Parrish, 2024; J, 2024). Nevertheless, the integration of AI in educational assessment has also raised concerns related to academic integrity, student originality, and the ethical boundaries of automated evaluation (Chan & Lee, 2025).

Although research on AI in education has grown substantially, a critical gap persists in understanding how AI can be meaningfully aligned with authentic assessment principles within the framework of the Merdeka Curriculum, particularly in the context of chemistry education and scientific literacy development. Existing studies tend to emphasize general AI functionalities or technological affordances (Kofinas et al., 2025; Thanh et al., 2023), while paying limited attention to the human-centered and ethical dimensions required to support authentic and reflective assessment practices (Picasso et al., 2024; Wahidin et al., 2025). Therefore, this integrative literature review synthesizes findings from thirteen international studies published between 2023 and 2026 to examine how the collaboration between AI and the Merdeka Curriculum can transform chemistry assessment into a more adaptive, ethical, and student-centered system.

2. METHODOLOGY

2.1. Research Design

This study employed an Integrative Literature Review (ILR) design to synthesize and critically evaluate research on the transformation of authentic assessment through the integration of Artificial Intelligence (AI) in education. The ILR approach allows the integration of theoretical, empirical, and conceptual studies to produce a comprehensive understanding of emerging educational phenomena (Snyder, 2019; Whittemore &

Knafl, 2005). This design was selected because it facilitates an in-depth examination of how AI-based tools influence authentic assessment design, implementation, and evaluation within 21st-century learning frameworks.

2.2. Sources of Data

The data of this study consisted of thirteen peer-reviewed journal articles published between 2023 and 2026. The selection process followed a systematic screening procedure to ensure transparency, as visualized in the PRISMA flow diagram (see Figure 1) (Page et al., 2021). Articles were purposively selected from reputable databases using the search terms "artificial intelligence," "authentic assessment," "learning," and "education." The inclusion criteria were as follows:

1. Articles focusing on authentic assessment in educational or learning contexts;
2. Studies integrating AI-based or digital assessment technologies for feedback, evaluation, or learning enhancement; and
3. Research demonstrating relevance to 21st-century competencies, critical thinking, and creative problem-solving.

The final corpus included the following thirteen studies:
(Chan & Lee, 2025; Cole, 2023; Fatima et al., 2024; Kirsanov et al., 2026; Kofinas et al., 2025; Lawrie, 2023; Mokganya & Zitha, 2025; Moreira & Hadjipieris, 2024; Picasso et al., 2024; Salinas-Navarro et al., 2024; Thanh et al., 2023; Wahidin et al., 2025; Yung et al., 2024)

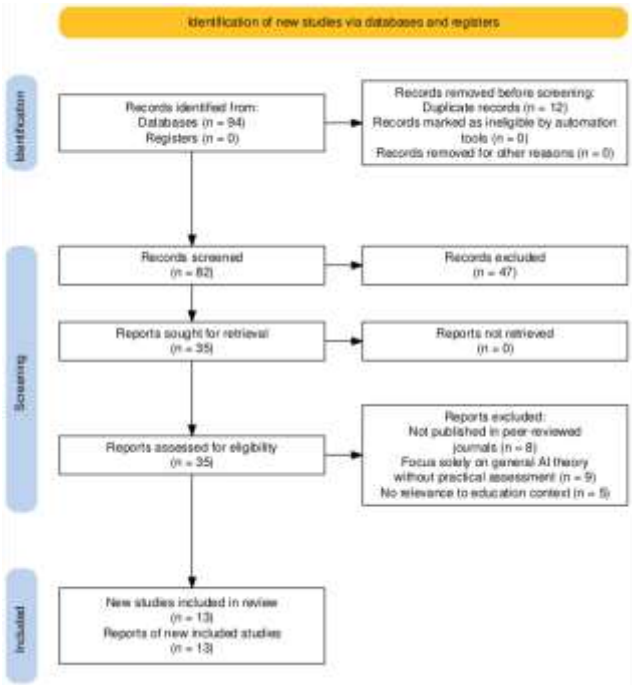

Figure 1. PRISMA Flow Diagram of the Literature Selection Process

2.3. Data Analysis Techniques

Data were analyzed through four systematic stages adapted from integrative review procedures:

1. Identification: reviewing the objectives, designs, and outcomes of each study;
2. Screening and Selection: applying inclusion and exclusion criteria to ensure focus on AI-integrated authentic assessment;
3. Categorization: organizing studies into emerging thematic clusters such as AI-enhanced learning, academic integrity, pedagogical authenticity, and ethical implications; and
4. Synthesis and Interpretation: integrating findings across studies to construct a conceptual framework describing how AI supports authentic assessment in education.

3. RESULT AND DISCUSSION

The synthesis of thirteen peer-reviewed journal articles published between 2023 and 2026 revealed three central findings regarding the transformation of authentic assessment through Artificial Intelligence (AI) integration in educational and scientific contexts.

Table 1. Synthesis of AI-Integrated Authentic Assessment Transformation (2023–2026)

Theme	Transformation & Key Findings	Supporting Sources	Relevance to Merdeka Curriculum & Chemistry
Experiential & Reflective Learning	AI enhances inquiry skills, conceptual understanding, and provides dialogic feedback for deeper engagement.	Salinas-Navarro et al. (2024); Lawrie (2023); Cole (2023)	Supports project-based laboratory activities and reflective scientific inquiry.
Ethical & Integrity Tension	Tension between AI's capability to mimic authentic responses and the need for academic honesty.	Thanh et al. (2023); Kofinas et al. (2025); Kirsanov et al. (2026)	Focuses on developing character and integrity in the Profil Pelajar Pancasila.
Pedagogical Innovation & Agency	Redefining teacher roles through data justice, adaptive feedback, and fostering student self-agency.	Picasso et al. (2024); Moreira & Hadjipieris (2024); Fatima et al. (2024); Chan & Lee (2025); Mokganya & Zitha (2025)	Promotes learner-centeredness and inclusivity in diverse chemistry classrooms.
Future Model: AI-Reflective	A shift toward augmented human reflection and professional identity cultivation.	Wahidin et al. (2025); Yung et al. (2024)	Prepares students for AI-mediated scientific environments.

First, AI acted as a catalyst for experiential and reflective learning. Studies by Salinas-Navarro et al. (2024) and Lawrie (2023) demonstrated that generative AI tools enhanced students' conceptual understanding, inquiry skills, and reflective experimentation. Similarly, Cole (2023) reported that professional conversation–based assessments supported by AI facilitated dialogic feedback and deeper engagement with authentic tasks.

Second, a recurring challenge involved the tension between authenticity, academic integrity, and technological dependence. Thanh et al. (2023) and Kofinas et al. (2025) found that generative AI could reproduce authentic responses, potentially compromising originality and integrity. Kirsanov et al. (2026) identified students' deliberate concealment of AI-generated content in online assessments.

Third, AI fostered pedagogical innovation by redefining teachers roles and promoting learner agency. Picasso et al. (2024) and Moreira and Hadjipieris (2024) showed that data-driven AI analytics supported adaptive feedback and inclusivity through a data justice approach. Fatima et al. (2024) and Chan and Lee (2025) highlighted the potential of AI-based assessments to facilitate collaboration and self-evaluation, while Mokganya and Zitha (2025) emphasized the importance of maintaining scientific interpretation and epistemological integrity in AI-mediated tasks.

Collectively, the reviewed studies demonstrated a shift from AI-assisted assessment toward AI-integrated and AI-reflective models (Wahidin et al., 2025; Yung et al., 2024), where authenticity was redefined through the balance between technological mediation, human judgment, and ethical awareness.

The findings further indicated that AI integration reshaped the epistemological and ethical dimensions of learning evaluation. These transformations aligned with the Merdeka Curriculum's emphasis on critical thinking, creativity, collaboration, and communication (4C) within the Profil Pelajar Pancasila framework.

The first theme suggested that AI-supported tools enabled experiential authenticity, allowing learners to engage in simulated scientific practices mirroring real-world inquiry (Lawrie, 2023; Salinas-Navarro et al., 2024). Such practices enhanced reflective learning cycles by linking experimentation with personalized feedback, consistent with constructivist principles in chemistry education.

The second theme revealed critical ethical and pedagogical challenges. The capacity of generative AI to perform complex tasks blurred the boundaries of originality and authorship (Kirsanov et al., 2026; Thanh et al., 2023). Kofinas et al. (2025) recommended redesigning assessment tasks that foreground process transparency and contextual adaptation. These insights highlighted the need for teacher assessment literacy to ensure fair and human-centered AI utilization.

The third theme underscored a paradigm shift toward human–AI collaboration in assessment design. Picasso et al. (2024) advocated for ethical governance of AI through

fairness and inclusivity principles, while Fatima et al. (2024) and Moreira and Hadjipieris (2024) demonstrated how AI-enhanced analytics could improve formative feedback loops and learner self-agency. In chemistry education, these models were relevant for assessing experimental reasoning and problem-solving skills while maintaining the interpretive nature of scientific inquiry (Lawrie, 2023).

Furthermore, emerging AI-reflective assessment models (Mokganya & Zitha, 2025; Wahidin et al., 2025; Yung et al., 2024) indicated that the future of assessment lies not in automation but in augmented human reflection. Within the Merdeka Curriculum context, this transformation fosters ethically grounded, data-literate, and self-regulated learners capable of navigating AI-mediated learning environments.

Overall, the integrative synthesis confirmed that AI-based authentic assessment can enhance educational equity and innovation while preserving humanistic values. Sustainable transformation depends on balancing technological efficiency with ethical awareness and pedagogical authenticity, ensuring that assessment continues to serve as a process of learning rather than a mere act of measurement.

4. CONCLUSION

This integrative literature review concluded that the integration of Artificial Intelligence (AI) into authentic assessment practices has redefined the nature, purpose, and ethics of educational evaluation, particularly in science and chemistry learning. The synthesis of thirteen international studies published between 2023 and 2026 revealed that AI functions as both a catalyst and a disruptor within the assessment landscape.

First, AI-enabled authentic assessments enhance experiential and reflective learning by simulating real-world inquiry, providing automated feedback, and personalizing student learning trajectories. Second, the growing tension between authenticity and academic integrity underscores the necessity for ethical literacy and assessment transparency among educators and learners alike. Third, AI promotes pedagogical innovation and teacher–learner collaboration, emphasizing assessment as an interactive, data-informed, and human-centered process.

In the context of the Merdeka Curriculum, these insights suggest that AI-driven authentic assessments can support the development of Profil Pelajar Pancasila by fostering critical thinking, creativity, collaboration, and scientific literacy. However, sustainable implementation requires educators to adopt a balanced approach—using AI as a co-assessor rather than a replacement for human judgment.

Suggestions arising from this study emphasize the importance of teacher professional development in AI literacy, ethical assessment design, and digital pedagogical competence. Curriculum developers are encouraged to integrate AI-based tools within national frameworks to enhance feedback quality and equity in chemistry education. Future research should investigate context-specific models of AI-supported

authentic assessment in Indonesian schools, particularly those aligned with the reflective and inquiry-oriented principles of science learning.

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Strategy of Character Building Based on the Love Curriculum in Islamic Religious Education Subjects

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ABSTRACT

We are currently in an era of digitalization that has had a profound impact, both positive and negative. This has affected the character of this nation's generation, giving rise to various undesirable traits among the community, such as juvenile delinquency, illegal drug use, free sex, and other negative behaviors. This situation highlights the importance of character education. The love curriculum focuses more on character education because it is the main foundation for its implementation. This curriculum aims to shape a generation that is not only intelligent but also loving, tolerant, environmentally conscious, and embraces diversity, uniting humanity with a foundation of love. This study focuses on character-building strategies based on the Love Curriculum in Islamic Religious Education. The purpose of this study is to explore character-building strategies based on the Love Curriculum in Islamic Religious Education. The research method used in this study is a qualitative approach with descriptive analysis. The researcher obtained data through observation, interviews, and documentation of people or institutions related to this study. The results of the study prove that the Love Curriculum is a character-based curriculum and its implementation is going well because each component of the curriculum is understood and implemented to the fullest. Within the Love Curriculum components, there are five main pillars of character known as Pancacinta. The strategies for character building in the Love Curriculum learning process are teacher role modeling, cultivating a loving and caring environment, organizing activities aimed at character building, and selecting learning methods that support the character building process of students.

Keywords: *Strategy, Character Building, Love-Based Curriculum, Islamic Religious Education, Subjects*

1. INTRODUCTION

The impact of globalization is like a double-edged sword, with positive and negative consequences that balance each other out. Competition, integration, and cooperation are the positive effects of globalization. Meanwhile, the negative effects include the emergence of an instant generation, moral decadence, and consumerism. Other negative effects include the emergence of violence, drug abuse, promiscuity, and crime. All of these negative things lead to a loss of character.

This situation illustrates the importance of reconceptualizing the idea of moral education or character education discourse. It is clear that national education at every level is becoming increasingly urgent, especially character education. Education is the basic capital for students to face their future world. The education referred to is holistic

and comprehensive education that prioritizes three important aspects, namely cognitive, psychomotor, and affective. The world of education is constantly evolving with the times, requiring innovation in learning methods to remain relevant and effective (Al Abror & Hosna, 2022). However, education needs to be applicable to humanize humans by not focusing on mastery of only one aspect but rather being balanced and complementary, especially in the aspect of character development and internalization.

The implementation of the love curriculum emphasizes character and moral strengthening. It involves a series of activities or learning experiences that not only focus on academic knowledge but also provide space for the development of students' character and personality (Muttaqin, 2021). One approach that is currently developing and is considered effective in character education is the Love Curriculum. The Love Curriculum does not only focus on achieving academic competence, but also on developing moral and social values that involve emotional aspects and interpersonal relationships in learning. This concept emphasizes the importance of instilling values such as compassion, empathy, tolerance, and cooperation in interactions between students, teachers, and the community (Nada and Listiana, 2025).

Islamic Religious Education attempts to present this through habituation and good ethics. Learning in Islamic Religious Education plays an important role in educating students, also because the scope of Islamic Religious Education can shape noble character that will lead Indonesians to be competent in all aspects of life, which essentially means becoming people of good character. This has been attempted in the learning process at Catak Gayam 02 Jombang Public Elementary School, particularly in Islamic Religious Education, where there is an emphasis on instilling character in students in the implementation of learning activities at school. Among other things, there is attendance using the flower line method as an effort to instill discipline, every student is required to shake hands and say hello every time they meet a teacher, This aims to improve politeness. The activity of praying together at noon trains discipline and responsibility. Commemorating important days with various methods and strategies strengthens the character of faith in students.

2. METHODOLOGY

The research method used in this study is qualitative, which is based on various exploratory activities to understand and explain the issues that are the focus of this study. This study aims to explain and analyze the character building strategy development program for students based on the love curriculum in Islamic education at Catak Gayam 02 Jombang Public Elementary School through a process of triangulation of methods, techniques, and research subjects, with a total of 95 people interviewed. Qualitative research is a research procedure that produces descriptive data in the form

of written or spoken words from people and observable behavior. According to Bodgan and Taylor, as quoted by Lexi J. Moleong (1993:3), a qualitative approach is a basic research procedure that produces descriptive data in the form of written or spoken words from people and observable behavior. Basically, this research examines the phenomenon of human social experience as seen from the participant's point of view by describing it. Understanding is obtained through analysis of various connections from participants and through an explanation of the "participant's meaning" of situations and events. Participant meanings include the feelings, beliefs, ideas, thoughts, and activities of participants (Sukamadinata, 2012:94).

This research is qualitative research with a descriptive approach that aims to describe existing phenomena, which are happening at the present time or in the past. From Islamic Education Teachers as implementers of the Curriculum in classroom learning activities, it is hoped that data will be obtained on the substance of policies related to the Curriculum Development program for Love in Islamic Education Learning in character building for students. From the Principal, data can be obtained on how the Curriculum Development programs for Love in Islamic Education Learning in character building for students are implemented and evaluated.

3. RESULT AND DISCUSSION

3.1. Components used to instill character in students in the learning process based on the Love Curriculum for Islamic Religious Education at Catak Gayam 02 Public Elementary School in Jombang

Discussing the implementation process of a curriculum means discussing the four important components of a curriculum. These four components are objectives, content, strategies, and evaluation. Therefore, this study will discuss the objectives contained in the Love Curriculum. The objectives we discuss start from national education objectives, the objectives of an educational institution, to the objectives in the learning process. This curriculum aims to produce individuals who are humanistic, nationalistic, naturalistic, tolerant, and always prioritize love as a basic principle in life (Ministry of Religious Affairs, 2025). The objective of the Love Curriculum is to shape a generation that is not only intellectually intelligent but also emotionally and spiritually mature, which is realized through the strengthening of tolerance, nationalism, and compassion. This curriculum aims to educate students to love others in diversity, respect differences, and contribute to the integrity of the nation. In addition, this curriculum also serves as a bulwark against radicalism and violence.

After discussing the characteristics of the objectives, the next discussion is the content of the Love Curriculum. The characteristics that are highlighted in the Love Curriculum are humanism, tolerance, empathy, love for others, care for the environment, and nationalism. These characteristics are instilled through the integration of values of

love and care in every aspect of learning, with a focus on respect, togetherness, and responsibility. Furthermore, this study discusses the strategies used as efforts to achieve character building in students by integrating the values of love (towards God, others, oneself, the environment, and the country) into all aspects of learning, both through pedagogical approaches such as project-based learning and habituation, and through the active role of stakeholders (teachers, parents, and the community) to set an example and create a conducive environment. Finally, the last aspect is the form of character-based evaluation in the implementation process of the Love curriculum. The evaluation of character education in the love-based curriculum can be carried out through the assessment of student behavior (such as empathy, concern, and social interaction), analysis of student work (e.g., writing or social projects), and self and peer assessment to measure self-awareness of character using authentic assessment.

3.2. Strategies in the learning process based on the Love-Based Curriculum for Islamic Religious Education as an effort to instill character in students

Strategies in PAI learning based on the Love-Based Curriculum (KBC) focus on character building through learning centered on love, empathy, and compassion. Some of the main strategies are integrating the value of love into each subject, using methods that create positive interactions and set direct examples, involving students in social activities, and developing a systematic schedule of activities to monitor their learning progress.

Strategies in PAI learning based on the Love-Based Curriculum

1. Integrating the value of love: Incorporating the values of love, empathy, and compassion into every PAI subject. This can be done by telling stories of prophets who were full of compassion, such as the story of the Prophet Muhammad SAW, to set an example for students.
2. Using teaching methods that reflect compassion: Teachers can be direct role models by showing compassion, care, and empathy to students. This method can create positive relationships and motivate students to do the same.
3. Encouraging social interaction: Inviting students to participate in social activities based on the values of the Qur'an, such as social service. Through these activities, students learn to show compassion and care for others.
4. Developing schedules and monitoring progress:
   - o Systematically scheduling learning activities and recording student progress through comprehensive and periodic assessments.
   - o Managing student motivation by creating ways to increase their enthusiasm for learning.
   - o Supervising learning by giving students the freedom to choose learning activities that suit their characteristics.

5. Collaborative approach: Building synergy with other parties for the reform of teacher recruitment and training policies based on ethical-spiritual competencies.
6. Emphasis on five main themes:

- Love for Allah
- Love for others
- Love for oneself
- Love for the environment
- Love for the nation and country

By implementing the above strategies, it is hoped that students will have strong character and good morals.

The strategies used in the implementation of the Love Curriculum learning process, especially in Islamic Religious Education, are divided into strategies based on the Love-Based Curriculum, specifically PAI, which includes strategies based on character development and values of love, as well as learning strategies that focus on interaction, experience, and reflection. Learning strategies through:

1. Cooperative learning: Encouraging students to work together in small groups to improve team performance, even though they are tested individually.
2. Problem-based learning: Involving students in solving real problems to improve their understanding and skills.
3. Innovation and adaptation: Educational units can adopt or adapt existing models and approaches to produce a curriculum that is more suited to their needs.

Strategies in character building of students and strategies in the learning process. According to Kemp (in his book Vina Sanjaya, 2008), there is a difference between strategy and method. Strategy involves planning, so strategy is the planning of an activity to achieve a goal, while method is the means used to implement the plan to achieve the predetermined goal.

Based on this theory, this strategy component is divided into two types, namely strategies for instilling character in students, which will discuss the plans used to realize character education in students. The second strategy is the learning strategy used for classroom activities, commonly known as the learning method, which aims to instill character in students at Catak Gayam 02 Jombang Public Elementary School. Strategies in the process of instilling character in students can be seen from the following:

1. Teacher role modeling

The attitudes and behaviors of students arise from imitating the behaviors and attitudes of teachers and educational staff at school. This role modeling can include attitudes in speaking, politeness in conveying something, manners in discipline and responsibility, modesty in dress, persistence in working hard, and so on. The basic behavior of a child is to imitate and follow what they see and hear. Therefore, teacher

role modeling is essential in shaping student character. In this case, a teacher who has the spirit of an educator, better known as ruhul mudarris, is needed. That is, a teacher who is sincere, faithful and pious, resilient, honest, polite, confident, hardworking, and loves their work so that whatever they do is for the sake of worship.

2. Giving Rewards and Punishments

Praise and rewards are a positive reinforcement strategy. Children who do good deeds will receive recognition from their environment and will learn to always do good, thus forming good character. Conversely, children who do wrong but are not reprimanded or punished will continue to grow with negative character traits because there is no response to their mistakes. Therefore, rewards and praise are necessary to foster good character in children.

3. Character Education Socialization

Posting signs that encourage children to always do good will help them to develop good character. Examples of signs containing messages of kindness and aimed at shaping character include: honest people live prosperous lives, cleanliness is part of faith, a quiet classroom is a comfortable place to study, and so on.

4. Cultivating a Character-Building Environment

Instill habits or routines in students to regularly do things that have moral value. Good deeds that become daily habits and are done repeatedly will shape good character. Examples include discipline in maintaining environmental cleanliness by doing classroom cleaning every morning, and the flower parade tradition, where children who arrive early are entitled to have their flower pots, labeled with their names, placed in the first row, neatly lined up in front of the classroom. This trains students to be disciplined in arriving early and on time.

5. Organizing School Activities that can Shape Character.

For example, commemorating Islamic holidays, such as the slaughter of sacrificial animals on Eid al-Adha, is expected to shape the character of willingness to sacrifice, as exemplified by the Prophet Ibrahim. Poetry reading and public speaking competitions are a means of training courage and creativity, while performing the midday prayer in congregation trains orderly and disciplined worship. As well as other activities aimed at character building for students.

6. Selecting appropriate learning methods that are active, innovative, creative, and enjoyable.

With this strategy, it is hoped that learning activities that take place in the classroom can realize the objectives of the Love Curriculum, namely to shape students with character.

Teaching methods that are appropriate for the material in Islamic Education subjects that can shape the character of students are:

a. Lectures

The lecture teaching method is used to deliver teaching material and motivate students to always behave well and correctly. Islamic Education material that needs to use the lecture method includes explanations about the example set by the Prophet Muhammad, the correct procedures for performing prayers, etc.

b. Question and answer

The question and answer method used in Islamic Religious Education learning activities aims to stimulate students' reasoning and creativity.

c. Matching/sequencing pictures

This method can be used to train students' memory in memorizing one of the pillars of worship, such as the pillars of wudhu, the pillars of prayer, etc.

d. Demonstration

This method is used when presenting material that must be demonstrated by the teacher or by inviting an expert, so that students can better understand what the teacher is explaining. For example, inviting a qari to demonstrate how to read the Quran, or inviting a doctor to explain how to maintain health and personal hygiene.

e. Discussion

The discussion method aims to build character traits such as courage, caring for others, respecting others, honesty, and politeness in expressing opinions.

f. Role-playing

This method is very effective when the material presented is related to Islamic role models. By presenting it in the form of a drama or other performance, students will be more impressed and will remember it more easily.

g. Storytelling

This method is very good for conveying stories of the exemplary lives and struggles of Islamic figures, such as the stories of the Wali Songo, the stories of the Prophets and Messengers, and so on.

In the Love Curriculum, teachers are required to have PAI teaching methods that are no longer boring and overly dogmatic. PAI teachers in the Love Curriculum are required to conduct integrated moral and character supervision. Assessment is not only based on cognitive abilities in PAI grades, but also on the affective and psychomotor aspects of students.

The learning process in educational units is conducted in an interactive, inspiring, enjoyable, and challenging manner, motivating students to participate actively and providing sufficient space for initiative, creativity, and independence in accordance with the talents, interests, and physical and psychological development of the students. To that end, each educational unit plans, implements, and assesses the learning process to improve the efficiency and effectiveness of graduate competency achievement. With the selection of appropriate strategies and correct learning methods, it is hoped that the perfect character of students can be formed and the national education goal of forming intelligent and competitive Indonesian individuals (perfect individuals) who are spiritually, emotionally, socially, intellectually, and kinesthetically intelligent can be realized.

3.3. Assessment methods for Islamic Religious Education based on the Love Curriculum for character building among students at Catak Gayam 02 Public Elementary School in Jombang

The assessment methods for Islamic Religious Education based on the Love Curriculum at Catak Gayam 02 Public Elementary School in Jombang use authentic assessment. The assessment of Islamic Religious Education based on the Love Curriculum includes the assessment of attitudes, knowledge, and skills that focus on the values of compassion, empathy, and humanity. The assessment can take the form of behavioral observation, student work portfolios, social projects, self and peer assessment, story and essay assignments, as well as discussions and presentations that reflect the character of love.

Forms of PAI assessment based on the Love Curriculum

1. Behavioral observation: Teachers directly observe students' behavior in interacting with others, the environment, and God, such as showing love, empathy, tolerance, and responsibility.
2. Portfolio: Collecting student work such as writing, drawings, or video recordings that demonstrate understanding and application of the values of love.
3. Social projects: Assessment of student participation in social activities such as community service, helping others in need, or environmental conservation projects.
4. Self and peer assessment: Students assess themselves and their classmates based on the criteria of love, such as honesty, empathy, and cooperation.
5. Story and essay assignments: Students are asked to write stories or essays describing their experiences in applying the value of love or analyzing characters who reflect this character trait.

6. Discussions and presentations: Assessment of students' ability to convey their ideas and opinions about the importance of love and how to apply it in everyday life.

The main objective of character building is to develop students who have humanistic, nationalistic, naturalistic, and tolerant characters, as well as love for God, others, themselves, the environment, and the country. From this explanation, it can be concluded that in the Love Curriculum, the assessment focuses not only on the results but also on the process during the learning process, from planning and implementation to the final stage of learning, namely evaluation. All of these are part of the assessment, so that the character development of students is truly taken into account.

4.IMPLICATIONS OF RESEARCH RESULTS

The deterioration of national character in this country indicates that one of the causes is the failure of education. By thoroughly studying a curriculum that serves as a barometer for the implementation of education, it is hoped that a quality learning process will occur. With a quality learning process, it is hoped that a quality generation will be formed and the goal of education will be realized, namely to develop well-rounded individuals who are physically healthy and have good character.

After undergoing a thorough planning process, selecting appropriate learning methods, continuous professional development for teachers, the creation of a character-building environment, and the provision of character-based evaluation at Catak Gayam 02 Jombang Public Elementary School, several implications or benefits were obtained from this study, namely quality Islamic Religious Education learning that is able to shape the character of students and fulfill the spiritual, social, knowledge, and skill aspects of students, including:

4.1. The creation of quality Religious Education learning

For an Islamic Religious Education teacher, understanding the components that support the implementation of a curriculum will enable them to create good and quality learning. Teachers will make careful learning plans, thoroughly understand the content and material of their lessons, choose good learning methods and strategies in the implementation process, and conduct proper evaluations.

4.2. The formation of professional Islamic Religious Education teachers

Professional Islamic Religious Education teachers understand the importance of good preparation in the planning process and are able to choose appropriate and effective learning strategies and methods. because choosing the right learning strategies will create active, innovative, creative, and enjoyable learning for students, supported by leadership that encourages teacher involvement in decision-making and provides support in the form of training and ongoing mentoring. This is what will become the capital for the successful implementation of an effective curriculum, which

must be supported by leadership that encourages teacher involvement in decision-making and provides support in the form of training and ongoing mentoring.

4.3. Monitoring the development of students' character

The final stage in a learning process is the evaluation or assessment stage. The Cinta Curriculum uses authentic assessment, an assessment technique that evaluates the entire learning process, from preparation and implementation to the final results of learning activities. This means that the development of all aspects of students will be monitored, from their spiritual and social aspects to their knowledge and skills, so that the development of their character can be monitored continuously. This will certainly be very beneficial for students, parents, and education stakeholders.

4.4. The formation of students with good character

With the proper implementation of a curriculum, the expected outcome is the formation of students with well-rounded characters in terms of physical and spiritual aspects, namely spiritual, social, knowledge, and skills.

5. CONCLUSION

There are four components used to instill character in students in the learning process based on the Love Curriculum for Islamic Religious Education at Catak Gayam 02 Public Elementary School in Jombang, namely curriculum objectives, curriculum content, strategies, and evaluation in the learning process, namely planning, implementation, and assessment. The strategies used in the learning process based on the Love Curriculum in Islamic Religious Education as an effort to instill character in students at Catak Gayam 02 Jombang Public Elementary School are divided into two, namely strategies for instilling character in students, including the exemplary behavior of teachers and all parties involved in the learning environment, giving rewards and punishments, socializing good character through billboards or writings on wall magazines, cultivating a character-building environment, holding activities that can shape student character, and choosing active, innovative, creative, and fun learning methods. Furthermore, the strategy in Islamic Religious Education learning is to select learning methods that are appropriate for the material being studied.The form of assessment for the Islamic Religious Education subject based on the Love Curriculum as an effort to instill character in students at Catak Gayam 02 Jombang Public Elementary School uses an authentic assessment approach, which is a comprehensive assessment starting from the preparation process, during the activity, and at the time of final evaluation. The selected assessment techniques can be in written, oral, product, portfolio, performance, project, observation, and self-assessment forms, and at the

elementary education level, character building is prioritized over academic development.

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Engineering Empathy and Inclusive Design in STEM-IoT Project: A Case Study of Adaptive Curriculum Strategy in Junior High School

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ABSTRACT

The increasing complexity of disaster-prone environments in Indonesia highlights the need for STEM learning models that cultivate both technical competence and human-centered design awareness. Yet, limited research has examined how STEM–IoT activities grounded in Design Thinking can simultaneously shape student empathy and teacher adaptability in authentic school settings. This qualitative case study examines how a STEM–IoT Mini Research Project (MRP) grounded in a Design Thinking framework for natural disaster mitigation fosters Engineering Empathy, Teacher Adaptive Strategies, and Student Autonomy. Data were collected through in-depth interviews (teachers and students), participatory classroom observations, and analysis of project artifacts, involving Grade IX students and STEM teachers at SMP IT Mentari Ilmu, Karawang, Indonesia. Thematic Analysis revealed three key findings: (1) Engineering Empathy emerged as a cognitive reasoning process that guided students to produce Inclusive Design solutions, demonstrated through multi-modal warning systems that accommodate diverse user needs; (2) Teacher Adaptive Strategies functioned as real-time instructional decision-making essential for managing the technical complexity of STEM–IoT tasks; and (3) the learning model successfully promoted Student Autonomy and intrinsic motivation throughout the project. These findings suggest that STEM–IoT curriculum innovation should position Engineering Empathy as a central driver of design quality, supported by teacher flexibility to maintain student agency. The study underscores the need for professional development emphasizing real-time troubleshooting and pedagogical adaptability.

Keywords: *Adaptive Strategy; Design Thinking; Engineering Empathy; Inclusive Design; STEM-IoT; Student Agency*

1. INTRODUCTION

The increasing frequency and intensity of natural disasters in Indonesia highlight the urgency of preparing students with both technical competencies and socio-emotional awareness to design meaningful solutions for real-world problems (BNPB, 2022; Sheehy, 2024). This condition positions STEM education as a strategic platform to develop students' ability to integrate scientific reasoning, technological fluency, and human-centered decision-making (Qin, 2022; McCurdy et al., 2020). Recent developments in educational technology show that the incorporation of Internet of Things (IoT) in project-based learning environments can enhance students' problem-solving engagement (Kakoulli & Evripidou, 2024; Ong et al., 2023), but managing this complexity requires structured frameworks such as Design Thinking that emphasize

user needs, iterative refinement, and contextual relevance (Penalva Tebar & Nah, 2024).

Design Thinking has been widely recognized as a pedagogical framework that supports empathy-driven innovation in STEM learning, particularly by encouraging learners to understand users' perspectives before designing technical solutions (Bush et al., 2022; Lin et al., 2023). Within this context, the concept of Engineering Empathy extends the scope of empathy beyond emotional sensitivity toward a more cognitive design reasoning process that guides how technical decisions are made to accommodate diverse users (Walther et al., 2017; Fila & Hess, 2016). Prior studies have shown that empathy can influence the quality of engineering design outcomes (Guanes et al., 2021). However, research that examines how empathy manifests in middle-school STEM–IoT projects, especially through Inclusive Design features such as multi-modal warning systems, remains limited (Burns & Lesseig, 2017; da Silva et al., 2025). In addition, implementing IoT-based STEM projects in schools demands substantial teacher adaptability, as teachers must navigate real-time troubleshooting, dynamic curriculum adjustments, and varied student readiness levels (Diana et al., 2021; Arlinwibowo et al., 2023).

Despite the growing interest in STEM–IoT integration, there remains a research gap concerning how students' Engineering Empathy develops in IoT-rich learning environments and how teacher Adaptive Strategies enable students to maintain autonomy when facing technical challenges (Walther et al., 2017; Lunn et al., 2022). This gap is particularly relevant in developing-country contexts, where disaster mitigation offers an authentic and locally meaningful problem domain for STEM learning (Sampurno et al., 2015; Shahidullah & Hossain, 2022). Understanding how curriculum adaptation unfolds in real classrooms is essential for designing scalable and sustainable STEM programs (Johnson et al., 2024; Pierson, 2024).

Therefore, this study aims to investigate how a STEM–IoT Mini Research Project (MRP) grounded in a Design Thinking framework for natural disaster mitigation fosters (1) Engineering Empathy, (2) Teacher Adaptive Strategies, and (3) Student Autonomy in a junior high school context. By analyzing students' design artifacts, classroom interactions, and teacher decision-making processes, this study provides insight into how empathic reasoning emerges in technical design tasks and how teacher flexibility supports sustained student engagement. This research contributes to the literature by proposing a conceptual linkage between Engineering Empathy and Inclusive Design in STEM–IoT projects and by highlighting the pedagogical implications for adaptive curriculum implementation in real-world school settings.

2. METHODOLOGY

2.1. Research Design

This study employed a qualitative case study design to examine how a STEM–IoT Mini Research Project (MRP) grounded in a Design Thinking framework was implemented in an authentic junior high school setting. A qualitative case study was selected to enable an in-depth exploration of learning processes, instructional adaptations, and participants' experiences related to Engineering Empathy, teacher adaptive strategies, and student autonomy within a bounded educational context.

2.2. Research Context and Participants

The study was conducted at SMP IT Mentari Ilmu, Karawang, Indonesia. Participants consisted of eleven Grade IX students enrolled in the STEM–IoT Mini Research Project and three STEM teachers (Science, Mathematics, and Informatics) who directly facilitated the project. Participants were selected through purposive sampling, targeting individuals who were most directly involved in and knowledgeable about the instructional processes and learning dynamics of the project.

2.3. Learning Context: STEM–IoT Mini Research Project

The STEM–IoT Mini Research Project was designed using the Design Thinking framework, encompassing the stages of Empathize, Define, Ideate, Prototype, and Test. Students were guided to develop IoT-based early warning system prototypes for natural disaster mitigation. The learning design emphasized human-centered problem framing, iterative design, and real-world contextualization, allowing both teachers and students to engage in flexible and adaptive learning processes.

2.4. Data Collection

Data were collected using multiple qualitative techniques to capture the complexity of classroom implementation:

1. In-depth interviews with students and teachers (11 interviews in total), focusing on students' reasoning processes, teacher decision-making, collaboration, technical challenges, and learning experiences.
2. Participatory classroom observations conducted over a four-week project period, documenting teacher–student interactions, troubleshooting activities, and design-related discussions.
3. Project artifact analysis, including student worksheets, design sketches, IoT code, testing videos, and final project presentations, to trace iterative thinking and design development.

2.5. Data Analysis

Data were analyzed using Thematic Analysis supported by NVivo 12. The analysis proceeded through three stages: (1) Open Coding to identify initial meaning units across interviews, observations, and artifacts; (2) Axial Coding to group related codes into conceptual categories such as empathy, adaptive scaffolding, problem-

solving, and autonomy; and (3) Selective Coding to synthesize categories into the study's three core themes: Engineering Empathy, Teacher Adaptive Strategies, and Student Autonomy. Triangulation across interviews, observations, and artifacts ensured the credibility and trustworthiness of the findings.

3. RESULT AND DISCUSSION

The data analysis identified one main selective theme: S1 — Engineering Empathy as a Pedagogical Engine. This core theme is supported by four axial categories: (1) AC1 (Empathy Engineering); (2) AC6 (Teacher Scaffolding); (3) AC7 (Design Thinking Operationaliza-tion); and (4) AC8 (Socio-Emotional Learning & Resilience).

3.1. Empathy Engineering (AC1): Emotional Grounding for Human-Centered IoT

Empathy emerged as the starting point of the entire process, triggered by the real and audiovisual disaster context. During the empathize stage, students showed affective reactions, imagined themselves as victims, and expressed a desire to prevent loss of life. This process indicates that empathy became a cognitive mechanism that guided how they defined the problem (Davis, 2023; Stoev & Stoeva, 2024).

> *"I imagined what it would be* like *if my mother were there. The device must respond quickly." — SPK-1, Female*
>
> *"If the* device *is late by just a few seconds, there could be more victims." — SPK-2, Female*

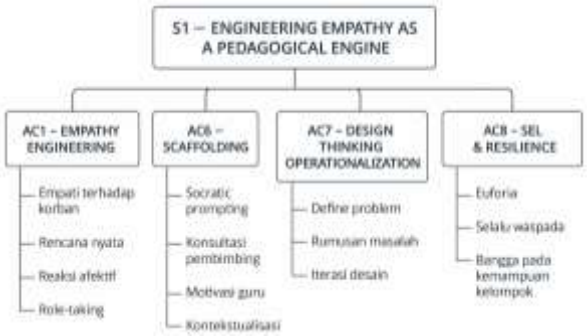

Figure 1. Hierarchy Chart AC1–AC8

The interconnectedness among the subcodes in AC1 (such as "affective reactions," "role-taking," "victims," "realistic planning") illustrates how emotional experiences became the starting point for scientific and technical reasoning. This aligns with the literature on empathy-driven design, which states that emotional engagement early in learning can increase the accuracy of problem definition and the relevance of technical solutions (Zhu et al., 2020; Lin et al., 2025).

> *"Eventually, that sense of empathy is what fostered their creative thinking... when they encountered an obstacle or challenge, they continued to explore—either by searching for information or asking the supervising teacher." — Guru_1/Male*

3.2. Adaptive Teacher Scaffolding (AC6) as Real-Time Curriculum Engineering

Teachers served not only as facilitators, but also as adaptive curriculum designers (Serrière & Daniela, 2025). They used Socratic prompting, individual consultation, enrichment of scientific understanding, and group-dynamics management to transform empathy into design action.

> *"I stimulated their critical thinking again. If we start from earthquakes, not all earthquakes cause tsunamis... eventually, they searched for which earthquakes trigger tsunamis. Then I asked again, what differentiates tsunami recession from gravitational tide recession? In the end, they searched again..." — Guru_2, Female*

In addition to conceptual prompting, teachers also carried out adaptive troubleshooting, namely, real-time instructional adjustments when student groups encountered technical difficulties. These improvisational actions do not appear in the written curriculum documents but emerged as responses to the complexity of IoT.

> *"I had to change the instructions in the middle because their device malfunctioned. But from that, they actually came to understand why prototypes must be tested repeatedly." — Guru_3, Male*

These actions transformed the enacted curriculum into a more responsive learning space while maintaining student agency in the face of technical failure (Barana et al., 2017; Al-Husban & Akkari, 2021).

Table 1 summarizes the distribution of axial coding intensity across teacher and student participants. The visual Matrix Coding shows that Guru_1 and Guru_2 have significantly higher intensity on AC1 and AC2 compared to students, while Guru_3 shows a major contribution to AC4 (scientific reasoning) and AC6 (scaffolding).

Table 1. Matrix Coding for Axial Themes

	AC1	AC2	AC4	AC5	AC6	AC7	AC8
Guru_1	16	13	0	0	0	0	
Guru_2	18	13	0	0	1	0	0
Guru_3	3	2	2	1	2	0	0
SPK_1	1	1	0	0		0	
SPK_2	1	1	0	0		0	
SPK_3	1	1	0	0		0	
SPK_4	1	1	0	0		0	

These patterns confirm that teachers' adaptive strategies constitute the strongest factor linking empathy with IoT-based design processes (Wambsganss et al., 2021).

3.3. Design Thinking as Non-Linear Operationalization (AC7)

Although the curriculum document describes the stages of Design Thinking in a linear sequence, the implementation in the classroom shows that the process unfolded

iteratively and circularly, following the emotional flow and reasoning of the students (Chakrabarti et al., 2025).

Table 2. Planned–Enacted–Experienced in Design Thinking

Stage	Planned	Enacted	Experienced
Empa-thize	worksheet	disaster videos, prompting	emotional reactions
Define	one definition	repeated revisions	redefinition of problem
Ideate	brain-storming	scientific prompting	integration of empathy values
Proto-type	one product	iterative	trial–error
Test	not detailed	simulation	reflection

This table shows that Define and Ideate experienced the most cycles.

"When we checked again, it turned out the problem wasn't the sensor, but the wave height. So we changed the problem statement again." — SPK-3, Female

"We went back and forth between ideation and prototyping because it kept failing." — SPK-1, Female

This reflects the non-linear nature of Design Thinking in disaster contexts, consistent with studies in humanitarian engineering (Allison & Palilonis, 2024). In addition to illustrating the iterative nature of Design Thinking, the data also show that the empathy emerging during the early stage directly influenced technical design decisions, especially regarding Inclusive Design features (Yuan & Dong, 2014). When students imagined diverse user conditions during a disaster, they began designing *multi-modal warning systems* combining sound (buzzer), light (flashing LED), and vibration. These technical decisions originated from empathic considerations for users who might be sleeping, unable to see, or unable to hear.

"I thought that if there are people who can't hear, the LED needs to be brighter and the buzzer must not be delayed." — SPK-4, Female

"... that's so there is sound, light, and also text. We wanted it to be fair, Sir. So people who are deaf or blind can also get the early warning." — SPK-3, Female

These findings strengthen the connection between Empathy Engineering and the production of more inclusive technical solutions (Afroogh et al., 2021).

3.4. Socio-Emotional Learning & Resilience as Emergent Outcomes (AC8)

The design process did not only produce technical artifacts but also significant development in socio-emotional aspects. These findings are clearly visualized in the Framework Matrix.

	Case	Planned	Enacted	Experienced
	SPK-1	Appreciate design ability	Pride in group's design skills	Pride in group's design skills
SPK	SPK-2	Always vigilant	Always vigilant	Do not panic; always vigilant
SPK	SPK-3	Unexpected outcome	Felt satisfied after success	Enjoyed creation process
SPK	SPK-4	Devoted in daily prayer	Devoted in daily prayer	Devoted in daily prayer

Figure 3. Framework Matrix — Planned/Enacted/Experienced for Each SPK

Based on the visualization, it is evident that each student demonstrated different forms of socio-emotional development. SPK-1 showed high self-efficacy, reflected in her pride toward the quality of her group's design. SPK-2 demonstrated emotion regulation, meaning she remained alert without excessive panic when facing technical challenges. SPK-3 displayed strong intrinsic motivation by enjoying the process of building the prototype and exploring design features. Meanwhile, SPK-4 expressed a form of spiritual resilience through consistent prayer and personal reflection throughout the project. These findings show that the disaster context and IoT design activities were able to evoke natural socio-emotional responses—not from direct instruction, but authentically emerging among the students (Rao et al., 2022).

3.5. Curriculum as Planned, Enacted, and Experienced

The Planned – Enacted – Experienced in Design Thinking table (see Table 2) shows a clear gap between the curriculum that was planned, the one enacted by the teacher, and the one actually experienced by students.

"The plan is only the beginning. In the classroom, we have to see what the students are like." — Guru_1, Male

"Sometimes what is planned must be changed in the field, must be adjusted..." — Guru_2, Female

Thus, the curriculum cannot be understood solely as a document, but as a living process negotiated between teachers, students, and context. In other words, the students' lived curriculum is far richer and more dynamic than the planned curriculum (Sherbine & Hara, 2020).

3.6. Student Autonomy and Agency in IoT Problem-Solving

Another important finding is the emergence of student autonomy, namely the ability of students to make technical decisions independently during the IoT design process (Wu et al., 2023). This autonomy appeared in how students performed debugging, tested prototypes, and corrected errors without waiting for teacher direction. In some groups, students even led the rhythm of teamwork, showing that agency became a natural part of the project.

"When the sensor malfunctioned, I checked the wiring myself, asked a friend, and only when stuck I went to the teacher." — SPK-3, Female

"When we were searching, we also had some difficulties... eventually we found alternatives ourselves—our creativity, you could say, Sir." — SPK-4, Female

This autonomy grew because the disaster context created a sense of moral urgency, making students feel responsible for producing accurate and safe solutions. Student agency was also strengthened by scaffolding strategies that provided room for trial–error and independent decision-making (Schwartz et al., 2021).

3.7. Integration of Themes: Empathy Drives Adaptation, Which Drives Inclusion

The selective coding results show a chain of interconnected findings:

Figure 4. Selective Coding Flow

This pathway becomes a new theoretical model that explains how STEM–IoT curricula can develop social sensitivity, inclusive design capability, and emotional regulation. The model illustrates that empathy is not only a learning objective but the engine that drives the entire process (Makweya & Sepadi, 2024).

3.8. "Project Map" as Narrative Synthesis of Findings

The NVivo coding and visualizations formed a complete picture of the relationships among the themes.

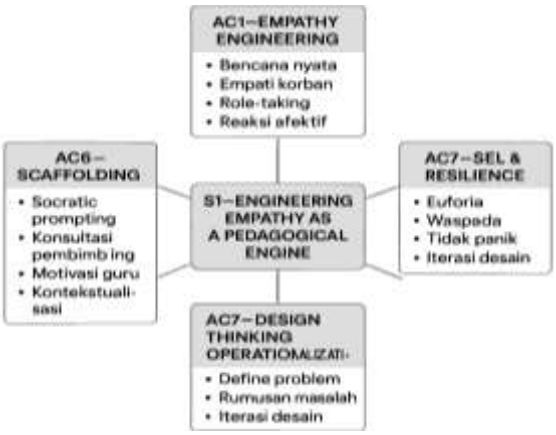

Figure 5. Causality Model of Engineering Empathy and Teacher Adaptive Strategies in the STEM–IoT Project

The Project Map shows that S1 functions as the central organizing system for the entire set of findings. Empathy Engineering (AC1) appears as the primary trigger that drives the design process, while Adaptive Scaffolding (AC6) acts as the connector that enables students to transform empathic understanding into more mature technical

decisions. Design Thinking (AC7) serves as the operational mechanism that directs the flow of iteration and problem-solving, whereas Social-Emotional Learning and Resilience (AC8) become the emergent outcomes of the process. Overall, this visualization reinforces that learning does not occur linearly but operates as an interconnected and mutually influential ecosystem.

3.9. Synthesis and Implications (Short Version with Citations)

Overall, the findings indicate that Engineering Empathy operates as a cognitive driver through which students interpret disaster problems and justify inclusive design decisions, aligning with research showing that empathy shapes engineering judgment and problem framing (Walther et al., 2017; Fila & Hess, 2016). Teacher adaptive strategies were essential in converting empathic insight into technical reasoning, consistent with literature on adaptive expertise and real-time instructional decision-making (Hayden et al., 2013). Design Thinking bridged emotional engagement and iterative prototyping, supporting prior evidence that empathic iteration deepens problem-solving (Razzouk & Shute, 2012). The emergence of socio-emotional learning—including resilience, calmness, and intrinsic motivation—aligns with theories of emotionally grounded learning (Dussault, 2024). Finally, the divergence between the planned, enacted, and experienced curriculum reinforces models of curriculum-as-lived, where learning emerges from dynamic negotiation among teachers, students, and context (Martín-Alonso et al., 2021; Remillard, 2018; Burke & Lehane, 2023). These insights highlight the importance of embedding empathy-rich contexts, supporting teacher flexibility, and providing space for authentic student autonomy in STEM–IoT learning environments.

4. CONCLUSION

This study concludes that a STEM–IoT Mini Research Project grounded in Design Thinking can effectively foster Engineering Empathy, Teacher Adaptive Strategies, and Student Autonomy in junior high school learners. Engineering Empathy emerged not merely as an emotional response to disaster contexts but as a form of cognitive design reasoning that guided students to produce inclusive and multi-modal early-warning solutions. Teacher Adaptive Strategies were found to be essential in bridging students' empathic understanding with technical problem-solving, particularly through real-time troubleshooting, responsive scaffolding, and improvisational guidance. These adaptive practices enabled students to sustain engagement while navigating the complexity of IoT prototyping. Furthermore, the project nurtured strong forms of Student Autonomy as learners independently refined problem definitions, conducted iterative testing, and made design decisions grounded in empathy and moral responsibility.

The findings suggest that STEM–IoT curriculum innovation should intentionally position Engineering Empathy as a central driver of design quality, supported by systematic opportunities for teacher flexibility. For schools and curriculum developers, this implies the need to incorporate authentic, context-rich problem domains—particularly disaster mitigation—to strengthen human-centered decision-making in STEM activities. For teachers, the study highlights the importance of cultivating adaptive expertise, especially in real-time instructional troubleshooting, to maintain student agency and problem-solving ownership. For policymakers and teacher education institutions, professional development should emphasize pedagogical adaptability, iterative design facilitation, and the integration of socio-emotional learning through experiential tasks. These recommendations aim to support broader implementation of empathy-driven, inclusive, and autonomy-enhancing STEM programs in diverse educational settings.

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Constructivist Facilitation and Ethical Learning Culture at SMP Eksperimental Mangunan

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ABSTRACT

This study examines how constructivist facilitation and ethical learning culture are enacted in the daily praxis of SMP Eksperimental Mangunan, a school known for its humanizing and student-centered philosophy. The research problem is rooted in the gap between the dominant instructional paradigm in Indonesian schools, characterized by teacher control, standardization, and transmission of knowledge, and the need for learning environments that nurture autonomy, participation, and ethical relationality. The purpose of this study is to analyze how learning facilitation is practiced, what ethical principles guide teacher–student interactions, and how these practices shape student learning experiences. Using an ethnographic qualitative approach, data were collected through prolonged classroom observations, in-depth interviews with teachers and students, document analysis, and participation in daily school activities. The results show that learning at Mangunan is facilitated through inquiry-based, dialogic, and experiential processes that position students as meaning-makers rather than passive recipients. Teachers act as facilitators who provide freedom, encouragement, and reflective scaffolding instead of control and evaluation- centered authority. Ethical practices emerge in the form of respectful communication, emotional attunement, dialogic conflict resolution, and relational pedagogy where students' voices are genuinely valued. Students report increased confidence, critical thinking, collaboration, and a sense of belonging. The findings discuss how facilitation and ethics intersect to produce a humanizing learning culture, one that supports cognitive growth through trust, care, freedom, and responsibility. Constructivist learning is not merely a method but a school-wide relational ethic. The study concludes that Mangunan represents a viable model for shifting from instructional control to facilitative praxis, offering insight for schools seeking transformative pedagogy. As a recommendation, schools and teacher education programs should embed facilitative competencies and relational ethics as core pedagogical standards, not complementary practices.

Keywords: *Constructivist Pedagogy, Ethical Practices, Facilitating Learning, Humanizing*

1. INTRODUCTION

The landscape of contemporary education is marked by tensions between traditional instructional paradigms and the growing demand for more humane, participatory, and constructivist-oriented approaches to learning. In many contexts, including Indonesia, the dominant pedagogical culture continues to rely on teacher-centered transmission, standardization, and compliance-based evaluation (Sagala, 2019; Suryadi & Idrus, 2021). This model positions the teacher as the primary authority and students as passive recipients of predetermined knowledge. While this paradigm

has long been institutionalized through curriculum structures, assessment systems, and school governance, it has also been widely critiqued for its inability to cultivate higher-order thinking, autonomy, ethical sensibilities, and deep learning (Darling-Hammond et al., 2020; Schleicher, 2018).

Constructivist theories of learning challenge this transmissive model by asserting that knowledge is actively constructed through interaction, dialogue, and reflection (Fosnot, 2013; Bruner, 1996). Learning therefore emerges not from the delivery of content but from processes of meaning-making embedded in real experiences. Vygotsky (1978) emphasizes that learning is fundamentally social, mediated by cultural tools and sustained through collaborative engagement within the Zone of Proximal Development (ZPD). These ideas, further developed by contemporary scholars of socio-constructivism, imply a radically different role for teachers: not as instructors who impose structure, but as facilitators who scaffold inquiry, support autonomy, and nurture relational trust (Sawyer, 2014; Murphy & Knight, 2016).

In parallel, a growing body of work highlights the importance of ethics, emotions, and relationality in education. Ethical pedagogy is not limited to moral instruction but encompasses the quality of interactions between teachers and students: respect, care, voice, recognition, and relational responsibility (Noddings, 2013; Biesta, 2022). Freire (1970) argues that humanizing education must be dialogical, grounded in mutual respect and the belief in learners' capacity to think, critique, and act. Such perspectives demand a shift from control-based teaching toward relational pedagogy, where learning is shaped through dialogue, empathy, and shared agency (Bingham & Sidorkin, 2004). Research also shows that when students feel respected and emotionally supported, they develop stronger motivation, deeper engagement, and a greater sense of belonging, critical elements of holistic learning (Wentzel, 2016; Zins et al., 2004).

Within this global discourse, SMP Eksperimental Mangunan has emerged as an important site for examining how constructivist facilitation and ethical learning culture can be enacted as daily praxis. The school's philosophy, deeply influenced by the humanism of Y. B. Mangunwijaya, foregrounds freedom, trust, and lived experiences as central to children's growth. Learning at Mangunan is intentionally organized to honor students' agency, curiosity, and emotional worlds. This provides a unique counter-narrative to the widespread empirical studies documenting how facilitation and relational ethics operate in everyday school life remain limited. Most research tends to focus on curricular policy, instructional strategies, or learning outcomes without addressing the relational and ethical dimensions that sustain meaningful learning interactions (Rahardjo & Juwita, 2022; Hasanah, 2020). There is also a shortage of ethnographic research that captures the lived experiences of teachers and students as they negotiate autonomy, voice, and emotional attunement inside classrooms.

2. METHODOLOGY

2.1. Research Design

This study employed a qualitative ethnographic research design. Ethnography is suited for examining cultural practices, relational behaviors, and pedagogical interactions within natural settings (Hammersley & Atkinson, 2019). Since the purpose of this study was to investigate how constructivist facilitation and ethical learning culture are enacted daily at SMP Eksperimental Mangunan, ethnography allowed for extended immersion in the field, capturing subtle relational dynamics and pedagogical patterns that cannot be observed in short- term visits.

Ethnography was chosen for three main reasons:

(a) To generate thick descriptions of learning facilitation as a social and cultural practice (Geertz, 1973).

(b) To understand relational ethics and facilitative interactions from the perspectives and lived experiences of teachers and students.

(c) To document school-wide norms, routines, and values that shape a humanizing learning environment. The research approach involved prolonged classroom observations, active participation in school routines, in- depth interviews, and document analysis.

This design aligns with constructivist and interpretivist epistemologies that view knowledge as socially constructed and context-dependent (Creswell & Poth, 2018).

2.2. Participants of the Study

The study used purposive sampling and criterion- based sampling (Patton, 2015). Participants were selected because they met specific criteria relevant to the research questions: (a) actively engaged in daily learning activities; (b) familiar with facilitative classroom practices; (c) part of the school's ethical and relational culture.

Table 1. Participants of the Study

Participant Criteria	Number Group	Selection
Teachers	7	Consistenly use dialogic, inquiry-based, and facilitative pedagogies.
Students	45	Represent Grades 7-9, diverse backgrounds, actively involved in Mangunan learning culture
School Principal	1	Understands the school's philosophy and pedagogical direction
School Staff	2	Enganged in routines shaping school culture

2.3. Data Collection

Data for this study were collected through four complementary qualitative methods that allowed for an in-depth understanding of the pedagogical and ethical culture at SMP Eksperimental Mangunan. First, prolonged classroom observations were conducted over a period of 30 consecutive days, covering various subject and grade levels. These observations generated detailed descriptive and reflective fieldnotes that captured the nuances of facilitation practices, ethical interactions, emotional climate, discourse patterns, and classroom dynamics.

Second, in-depth interviews were carried out with key participants, including seven teachers, forty-five students (interviewed individually or in small groups), and the school principal. Each interview lasted between 30 and 90 minutes and was recorded and transcribed verbatim to preserve the authenticity of participants' voices. Third, document analysis was used to examine a range of school artifacts, such as lesson plans, school philosophy statements, student journals and portfolios, and internal routine guidelines, which provided additional contextual insights into the school's pedagogical values and cultural norms.

Finally, the researcher engaged in participant observation by joining daily school activities, including morning circles, break-time interactions, community service engagements, and teacher meetings. This immersion enabled the researcher to access tacit cultural understandings and relational practices that might not surface through interviews or formal observations alone. Collectively, these methods created a rich, triangulated dataset that illuminated how constructivist facilitation and ethical relationality are enacted in everyday school life.

2.4. Data Analysis Techniques

Data analysis in this study followed the principles of thematic analysis as outlined by Braun and Clarke (2006), with the support of NVivo 14 software to manage, code, and organize the qualitative dataset. The process began with data familiarization, during which the researcher repeatedly read all forms of data, including fieldnotes, interview transcripts, reflective memos, and document sources, to gain a holistic sense of emerging patterns. Following this, initial coding was conducted inductively and deductively, generating codes that captured specific features of the data related to facilitative strategies, dialogic practices, emotional attunement, ethical relationality, student agency, collaboration, and conflict resolution.

After coding, the researcher searched for themes by grouping related codes into broader conceptual clusters such as constructivist facilitation, ethical relational practices, humanizing pedagogy, dialogic learning culture, and student autonomy. These preliminary themes were then reviewed in relation to the entire dataset to ensure coherence, internal consistency, and alignment with both empirical evidence and

theoretical frameworks. Once validated, themes were refined, defined, and named to represent clear conceptual categories grounded in constructivist learning theory, relational pedagogy, humanistic educational philosophy, and ethics in education. The final stage involved producing the analytic narrative, where the themes were synthesized into a coherent report that integrated empirical findings with relevant theoretical perspectives to generate an interpretive understanding of facilitative and ethical learning practices in the school context.

3. RESULT AND DISCUSSION

The findings of this study reveal how SMP Eksperimental Mangunan constructs a learning culture grounded in facilitation, ethical relations, and humanistic educational philosophy. Through prolonged observations, interviews with teachers and students, and document analysis, several interrelated themes emerged. These findings demonstrate how teachers shift from traditional instruction to dialogic, relational facilitation and how this pedagogical stance shapes students' agency, engagement, and ethical consciousness.

3.1 Constructivist Facilitation as the Core Pedagogical Practice

Across classrooms and learning activities, teachers consistently enacted facilitation rather than direct instruction. Instead of beginning lessons with explanations, teachers invited students to explore problems, ask questions, and construct ideas collaboratively. Observation data show that teachers routinely responded to student inquiries with counter- questions, such as "What do you think?", "Why do you think it happens?", or "Who has a different view?", which positioned students as active meaning-makers.

Teachers described this approach as a shift from "mengajar" to "membelajarkan," emphasizing learning as a dialogic and relational process. Interviews revealed that teachers viewed their role not as transmitters of knowledge but as designers of experiences and facilitators of student reasoning. This aligns with constructivist learning theory, where knowledge emerges through interaction, experimentation, and social negotiation.

Students also articulated a heightened sense of ownership of learning. Many reported that they "feel trusted" and "feel heard," highlighting how facilitation fosters both autonomy and intrinsic motivation. Classroom observations confirmed that students were more willing to take risks, challenge ideas, and contribute to group discussions when teachers positioned them as capable thinkers.

3.2 Relational and Emotional Pedagogy: Ethics, Care, and Classroom Climate

Findings from this study indicate that ethical relationality and emotional attunement are not separate dimensions of pedagogy at SMP Eksperimental Mangunan but form an integrated relational, emotional pedagogy that underpins all learning processes. Teachers' ethical practices are enacted through emotionally responsive interactions that cultivate trust, psychological safety, and a sense of belonging, thereby enabling meaningful engagement and deep learning.

Classroom observations consistently revealed that teachers prioritize relationships over procedural efficiency. Ethical relational practices were expressed through attentive listening, respectful dialogue, non-coercive guidance, and sensitivity to students' emotional states. Teachers frequently paused academic activities to acknowledge students' feelings, mediate interpersonal tensions, or facilitate reflective conversations. Such actions demonstrate that care and ethics are embedded in pedagogical decision-making rather than treated as supplementary or reactive measures.

Students described their teachers using relational terms such as *sahabat belajar* (learning companions), *pendamping* (mentors), and *teman bicara* (dialogue partners). These descriptions reflect a learning environment characterized by emotional closeness and mutual respect. Many students reported feeling "not afraid of being wrong," which encouraged them to express ideas, ask questions, and engage in dialogue without fear of judgment. This sense of emotional safety aligns with humanistic principles of empathy, unconditional positive regard, and authenticity (Rogers, 1969), as well as relational ethics emphasizing recognition and care (Noddings, 2013).

Emotions were treated as legitimate and integral to learning rather than distractions from academic goals. Observations showed that lessons often began with emotional check-ins, such as teachers asking students how they were feeling that day. These practices set a tone of openness and emotional acknowledgment, allowing students to bring their whole selves into the learning process. Emotional literacy was further developed through reflective discussions on conflict, fairness, responsibility, and personal growth, reinforcing students' ethical awareness and social understanding.

The classroom climate that emerged from these relational and emotional practices was marked by warmth, mutual respect, and collective responsibility. Physical arrangements, such as flexible seating and shared learning spaces, reinforced a sense of ownership and belonging. Peer interactions reflected high levels of care and cooperation, with students voluntarily offering support, validating each other's contributions, and resolving disagreements through dialogue. These dynamics demonstrate how emotional attunement and ethical relationality work together to sustain engagement and deepen learning.

The findings suggest that ethical pedagogy at Mangunan is not primarily rule-based or disciplinary in nature, but relational and affective. Ethics are lived through daily interactions that honor students' dignity, emotions, and voices. In this sense, relational and emotional pedagogy functions as a foundational condition for constructivist facilitation, enabling students to participate actively, take intellectual risks, and develop both cognitive and ethical capacities. This integrated approach reinforces the argument that humanizing education requires attention not only to how knowledge is constructed, but also to how relationships and emotions shape the conditions of learning.

3.3 Dialogic Learning Culture and the Centrality of Meaning-Making

The school fosters a dialogic learning culture where meaning-making occurs through collective inquiry. Conversations, not worksheets, lectures, or testing, serve as the main medium of learning. Dialogues were rich, open-ended, and collaborative, often extending beyond the academic content to include values, emotions, and lived experiences. Teachers facilitated discussions that invited multiple perspectives, encouraged disagreement, and supported students in justifying their reasoning. Discourse analysis from classroom dialogues revealed high levels of turn-taking, question-posing, clarification requests, and elaborations indicative of deep engagement.

During several observed lessons, students organically formed inquiry communities, using talk to explore concepts such as justice, environmental responsibility, social empathy, and personal identity. This aligns with dialogic theories (Freire, Bakhtin) where dialogue is a vehicle for critical consciousness and ethical awareness. In interviews, students reported that learning at Mangunan "feels like a conversation," "is connected to real life," and "helps us understand ourselves and others." Such remarks highlight the school's success in constructing learning as a meaning-making journey rather than a procedural academic task.

3.4 Student Autonomy and Agency as Outcomes of Facilitation

One of the most salient findings is the emergence of strong student autonomy as both a pedagogical outcome and cultural expectation. Across activities, students demonstrated independence in choosing tasks, organizing group work, negotiating roles, resolving conflicts, and seeking help when needed. Teachers intentionally designed learning spaces to support agency, for example, flexible seating, open access to learning materials, co-created class rules, and student-led presentations. Students frequently initiated questions, shared ideas without prompting, and made decisions about project direction.

Interviews revealed that students perceived autonomy not merely as freedom but as responsibility. They frequently used terms such as "*mengatur diri*," "*tanggung*

jawab," and "*berinisiatif*," indicating internalization of self-regulation and accountability. This agency extended beyond academic tasks. During break times, morning circles, and community service, students independently facilitated discussions, negotiated issues among peers, and demonstrated leadership. The findings suggest that facilitation-oriented pedagogy cultivates students' capacity for self-regulated learning, ethical decision- making, and collaborative problem-solving.

3.5 Ethical School Culture Beyond the Classroom

Ethical and facilitative practices extended into broader school life. Morning circles fostered democratic participation and communal bonding, while teacher meetings modeled the same dialogic and reflective practices used with students. Community service activities cultivated social empathy, responsibility, and connection to the environment. Document analysis confirmed that the school explicitly grounds its culture in values such as solidarity, justice, respect, and community participation. These values were not merely stated but observable in daily routines and teacher–student interactions.

The principal emphasized that ethical culture is "*bukan aturan, tetapi cara hidup bersama*" (not a rule, but a way of living together). This perspective was evident in how conflicts were resolved through dialogue rather than punishment, and how students were encouraged to reflect on the consequences of their action.

3.6 Synthesis: Interconnected Ecosystem of Facilitated, Ethical, and Humanizing Learning

The findings reveal an integrated ecosystem where constructivist facilitation, ethical relationality, dialogic culture, emotional attunement, and student agency work together to create a humanizing learning environment. These elements mutually reinforce each other:

(a) Facilitation cultivates autonomy and agency.
(b) Ethical relations nurture psychological safety and trust.
(c) Dialogic practices deepen meaning-making and critical thinking.
(d) Emotional attunement strengthens engagement and belonging.
(e) School culture sustains values that permeate teaching and learning.

This ecosystem aligns with humanistic education (Rogers), dialogic pedagogy (Freire), constructivism (Vygotsky, Piaget), and contemporary theories of ethical and relational teaching (Biesta, Noddings). Overall, the results demonstrate that SMP Eksperimental Mangunan successfully embodies a model of education that is deeply facilitative, ethical, relational, and humanizing, providing an alternative to conventional, instruction- driven schooling.

4. CONCLUSION

This study set out to examine how constructivist facilitation and ethical learning culture are enacted at SMP Eksperimental Mangunan through the daily interactions between teachers and students. The findings reveal that Mangunan has successfully developed a pedagogical ecosystem where facilitation replaces control, dialogue replaces one-way instruction, and ethical relations replace authoritarian discipline. The first research question *how is learning facilitation practiced in the school?*, is answered through the observation that teachers consistently adopt inquiry-based, dialogic, and experiential approaches that position students as active constructors of knowledge. Facilitation emerges not merely as a teaching strategy but as a deeply embedded stance characterized by providing space, scaffolding thinking, encouraging questions, and nurturing students' autonomy.

The second research question, *what ethical principles guide teacher–student interactions,* is addressed through evidence of relational ethics embedded in everyday practices? Teachers demonstrate empathy, respect, emotional atonements, and non-coercive guidance, shaping a learning environment grounded in trust, care, and mutual dignity. Ethical practices are not confined to formal instruction but permeate school routines, conversations, conflict resolution, and shared community life, affirming that ethics is a lived experience rather than a set of rules.

The third research question *how do these pedagogical and ethical practices shape student experiences?* is answered by students' reports of increased confidence, critical thinking, agency, collaboration, and belonging. Students describe feeling heard, trusted, and valued, which enhances their willingness to take risks, articulate ideas, and engage deeply in learning. The school successfully fosters a humanizing learning culture that integrates cognitive, emotional, and social development, demonstrating that facilitation and ethics are mutually reinforcing.

Based on these conclusions, several suggestions emerge for educational stakeholders. For schools seeking transformative pedagogical change, it is recommended that facilitation be adopted not as an alternative method but as a foundational orientation toward learning. Creating dialogic spaces, encouraging student autonomy, and embedding reflective inquiry into classroom routines can support deeper engagement and ethical sensitivity. School leaders may consider reorienting institutional culture toward relational trust, shared responsibility, and collaborative decision-making so that ethical practice becomes a whole-school norm rather than an individual teacher's initiative.

For teachers and practitioners, the study suggests the importance of developing facilitative competencies such as crafting open-ended questions, offering non-directive guidance, listening with empathy, and cultivating emotionally safe learning environments. Professional development programs should integrate modules on

relational pedagogy, emotional atonement, and ethical classroom communication to strengthen teachers' capacity to enact humanizing practices.

For teacher education institutions, it is advisable to embed facilitative pedagogy and relational ethics as core components of curriculum rather than optional or supplementary topics. Pre-service teachers should be provided with authentic opportunities to experience facilitating learning, observing dialogic classrooms, and practicing ethical decision-making. Such preparation is essential for developing future educators who can shift from instructional dominance to facilitative praxis.

Finally, for policymakers, the findings indicate the need to design policies that allow schools greater flexibility in pedagogical design, assessment practices, and relational approaches to discipline. Policies should support schools that prioritize autonomy, participation, and holistic student development instead of reinforcing standardization and control.

In sum, SMP Eksperimental Mangunan offers a compelling model of constructivist and ethical education in practice. Its example demonstrates that humanizing, student-centered learning cultures can flourish when facilitation, dialogue, and ethics are intentionally cultivated as intertwined dimensions of schooling.

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Transforming Geometry Learning Through A GeoGebra-Assisted Boom Crane Path Modeling Task for 21st-Century Competencies

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ABSTRACT

This study presents an innovative integration of curriculum design and digital pedagogy through the development and testing of a mathematical modeling task aimed at transforming geometry learning in the digital era. Building on an initial study conducted in May 2025 that mapped students' basic modeling abilities in a senior high school in Bandung, significant weaknesses were identified in the stages of interpreting, validating, and evaluating models. Based on these findings, this research developed a mathematical modeling task grounded in the engineering phenomenon of boom crane motion, representing an authentic trajectory as a context for geometry learning, with GeoGebra utilized as a dynamic exploration tool. The task follows a complete modeling cycle designed to develop the full spectrum of Bloom's Taxonomy. The study employed a mixed-method approach, including expert design validation and field testing. The field trial involved high school students to examine the task's validity, comprehensibility, and effectiveness. The results indicate that the designed task has a high level of validity and is effective in improving students' ability to understand context, formulate models, develop spatial reasoning, and enhance higher-order thinking skills (HOTS). Weaknesses remain in the stages of mathematical solving and model evaluation. These findings demonstrate that integrating engineering contexts, modeling, and digital technology can strengthen the relevance and competence of 21st-century geometry learning.

Keywords: *curriculum innovation, GeoGebra, geometry learning, mathematical modeling*

1. INTRODUCTION

Mathematics education in the 21st century requires higher-order thinking skills (HOTS) and 4C skills integrated with digital literacy. However, instructional practices in Indonesia are still dominated by LOTS-oriented procedural approaches. Findings from PISA 2022 indicate a decline in Indonesian students' performance in mathematics, particularly in the aspects of contextual problem-solving and spatial reasoning (OECD, 2022; 2023). Countries such as Germany, Australia, Singapore, and China have responded to this global trend by explicitly integrating mathematical modeling into their curricula (Lee & Ng, 2015), thus underscoring the urgency of a similar pedagogical transformation in Indonesia.

In the realm of geometry, challenges arise as students tend to perceive the material as a collection of formulas rather than as representations of real-world phenomena. Research by Greefrath and Siller (2018) indicates that the gap between the abstract world and concrete contexts is at the root of students' low spatial and analytical abilities. The mathematical modeling approach offers a solution by engaging students in the process of identifying problems, simplifying, solving, and interpreting models (Blum & Borromeo Ferri, 2009; GAIMME, 2016). This approach affirms mathematics as a meaningful tool for thinking, not merely as algorithms.

Engineering contexts offer opportunities to present more authentic modeling experiences. Research by Frassia and Serpe (2017) shows that engineering objects can enhance students' reflective and spatial abilities in modeling tasks. The mechanical phenomenon of a boom crane, which involves rotation, elevation angles, and load trajectory, serves as an ideal context for GeoGebra-assisted geometry modeling tasks. Prior research on the effectiveness of GeoGebra in learning reinforces the idea of its integration in this study. Therefore, the development of a boom crane-based modeling task is expected to strengthen students' spatial thinking, visual representation, and mathematical creativity through the synergistic integration of mathematical modeling, digital pedagogy, and engineering contexts, as a relevant 21st-century learning practice.

Mathematical Modelling in Mathematics Education

Mathematical modeling is a systematic process of connecting real-world situations with mathematical representations through the stages of understanding, simplifying, formulating, solving, and validating within the original context (Blum & Borromeo Ferri, 2009; GAIMME, 2016). This process requires students to use mathematics not merely as a set of rules, but as a tool for thinking in solving ill-defined problems.

The modeling cycle, utilizing a diagnostic approach model from a cognitive perspective, serves as the foundation for a comprehensive understanding of mathematical modeling. In this modeling study, the modeling cycle/stages to be adopted are those proposed by Galbraith & Holton (2018). The mathematical modeling stages used in this study are as follows.

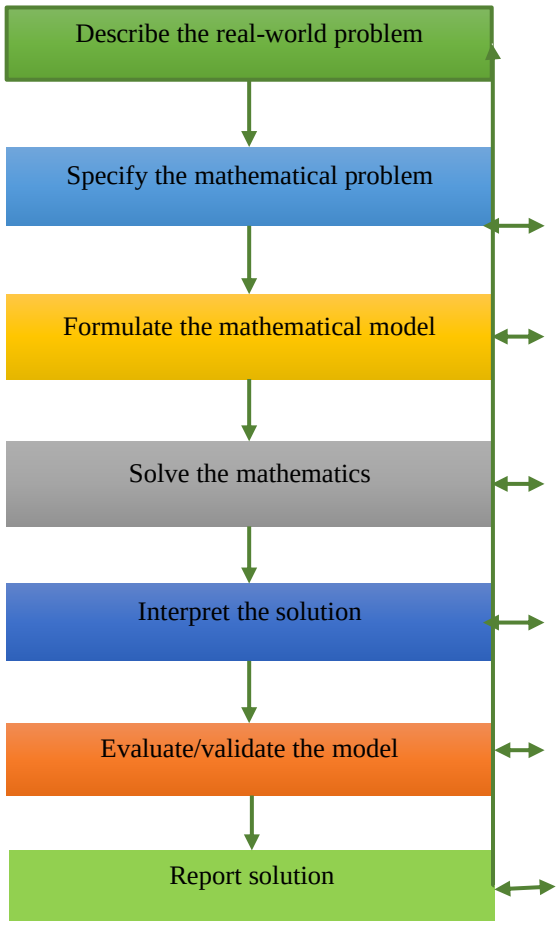

Figure 1. The Galbraith-Holton (2018) Modeling Framework

The research problem is formulated based on a triple deficit in mathematics education in Indonesia, namely: (1) a geometry abstraction deficit, wherein students are confined to symbolic procedures without developing visual–spatial understanding rooted in real-world contexts; (2) a digital exploration deficit, where GeoGebra is more frequently utilized as an illustrative tool rather than as a conceptual exploration medium that supports HOTS; and (3) a 21st-century skills gap, as reflected by the low performance in contextual problem-solving in PISA (OECD, 2022; 2023). Preliminary research findings (May 2025) indicate significant weaknesses in the model interpretation, validation, and evaluation stages, thus necessitating an intervention that enables students to take problem ownership and use GeoGebra as an environment for model construction and reflection in greater depth.

This study develops a modeling task based on the authentic, contextual, and open-ended phenomenon of a Boom Crane's end trajectory. Using GeoGebra as a digital cognitive space for construction, simulation, and reflection, this task targets the activation of analyzing, evaluating, and creating abilities. Pedagogically, this

intervention shifts learning towards student-centered learning, strengthening HOTS as well as 21st-century competencies such as collaboration and communication. Its success is evaluated through the quality of the models and changes in students' thinking processes, based on a modeling rubric and digital HOTS indicators.

This study aims to develop and implement a mathematical modeling task based on the Boom Crane phenomenon in GeoGebra-assisted geometry learning. In addition to evaluating its effectiveness in enhancing students' critical thinking, spatial, and collaborative abilities, this study also analyzes the modeling process that occurs during discussions and task completion. Thus, the study not only evaluates the final learning outcomes but also maps students' thinking dynamics, interactions, and mathematical representations as a reflection of 21st-century contextual learning.

2. METHODOLOGY

2.1 Research Design

This study adopts a qualitative-descriptive approach within the framework of Design-Based Research (DBR) to develop and test a prototype mathematical modeling task based on the boom crane engineering phenomenon. It utilized an iterative design cycle that included design, limited implementation, observation, and reflection (McKenney & Reeves, 2019). Data were collected through observation, interviews, and analysis of student work to ensure the design's validity and practicality, as well as to provide insights into how students construct and validate mathematical models within an authentic modeling context. Qualitative data were analyzed using a descriptive thematic analysis focusing on students' modeling processes across the seven stages of the Galbraith-Holton modeling cycle.

2.2. Participants of the Study

The subjects of this study were grade XI science (MIPA) students from Al-Azhar Syifa Budi Parahyangan High School, West Java, during the 2025/2026 academic year. Participants were selected using purposive sampling, considering variations in academic ability and active engagement in project-based learning. A total of 26 students participated, who were divided into 8 small groups to facilitate collaborative discussions during the modeling activities. Permission to conduct the study was obtained from the school, and students' participation was voluntary with all data anonymized for research purposes.

2.3 Research Instruments

The instruments used in this study consist of four components:

1. Task development instrument (task validation sheet)
2. Observation sheet of the modeling processes

3. Assessment rubric for students modeling products
4. Assessment rubric for HOTS and 4C

All instruments were reviewed by mathematics education experts to establish content validity prior to classroom implementation.

2.4 Data Analysis Techniques

Data analysis was conducted using a qualitative-dominant approach, supported by descriptive quantitative analysis according to the type of instruments employed.

1. Task Validation Sheet

   Expert validation data were analyzed quantitatively by calculating the average score for each aspect (content, construction, digital components, and practicality).
2. Observation Sheet of the Modeling Processes

   Data from observations of the seven modelling stages (Galbraith–Holton, 2018) were analyzed qualitatively through reduction, categorization, and thematic analysis within the DBR evaluation and reflection phase.
3. Modelling Product Assessment Rubric

   The data were analyzed using descriptive quantitative methods, while the qualitative interpretation focused on describing the characteristics of students' products, including accuracy, digital representation, and creativity.
4. HOTS and 4C Rubric

   The data were assessed quantitatively by calculating mean scores and analyzed qualitatively to interpret observable behaviors that reflect the development of HOTS and 21st-century skills.

Triangulation across observation data, student products, and rubric scores was applied to strengthen the credibility of the findings.

3. RESULTS AND DISCUSSION

Based on preliminary discussions with teachers at the observation school, mathematical modeling is still rarely implemented. Numerous factors must be considered, such as time constraints, student preparedness, and teacher readiness in preparing for modeling instruction. Nevertheless, the implementation of mathematical modeling has often been advocated for and is frequently discussed at the teacher deliberation forum (MGMP) level. Awareness of the importance of modeling instruction is significant; however, tangible support from relevant stakeholders is required for it to be implemented effectively.

Teaching materials pose a primary challenge, alongside teachers' modeling competencies. The design of modeling tasks cannot be arbitrary, as it must fulfill key criteria, such as relevance to students' real-life contexts and an appropriate level of problem difficulty to build students' modeling competencies. Proceeding from this fact,

the researcher decided to develop a modeling task related to geometry material, utilizing GeoGebra in the implementation of the modeling learning process.

3.1. Modeling Task Validity

Validation data were collected from the task validation results during the expert review stage. The validation assessed the content validity, task construction, digital integration, and implementation practicality of the boom crane mathematical modeling task prior to its classroom implementation. The validators consisted of expert lecturers in mathematics education and experienced senior high school teachers. On the validation sheet, the assessment scores provided were on a scale of 1 to 5. After the validation scores were obtained, they were categorized to determine the validity of the instructional material. The following are the validity categories based on the scores obtained, according to the guidelines in Sugiono (2014).

Table 1. Modeling Task Validation Results

No	Aspect	Average	Category
1	Content relevance	85%	Very Valid
2	Task construction	90%	Very Valid
3	Digital integration	80%	Valid
4	Implementation practically	75%	Valid
Overall		**83%**	**Very Valid**

3.2. Observation Results of the Students' Modeling Process

The following is a recapitulation of the observation results of the students' modeling activities, observed during the modeling process in the classroom. Each stage was developed into two indicators, which served as a guide for analyzing the attainment of each stage.

Table 2. Observation Results of the Student Modeling Process

No	Aspect	Average
1	Describing/Understanding	90,83%
2	Specifing/Simplifyng	78,83%
3	Formulating/Mathematising	73,08%
4	Solving	59,62%
5	Interpreting	61,54%
6	Evaluating/Validating	55,77%
7	Reporting	73,04%
Overall		**70.33%**

The observation results indicate that the students' modeling ability is in the 'good' category, with an attainment of 70.33%. This is characterized by high performance in understanding the context of the boom crane phenomenon, identifying variables, and formulating the mathematical problem. This finding confirms that students have mastered the fundamentals of modeling, but still require reinforcement in the analysis

and evaluation aspects so that the resulting models are more comprehensive and realistic.

During the modeling instruction, students were divided into heterogeneous ability groups, as recommended by school modeling experts. Although mathematics is often perceived as an individual activity due to the culture of individual assessment in schools, mathematical modeling is essentially teamwork. The problems encountered in modeling are generally complex and unstructured, thus requiring a collaborative approach. This aligns with the views of COMAP & SIAM (2019) and Kandemir & Erylmaz (2025), who assert that group work is highly recommended as it enables students to overcome modeling challenges more creatively and in a coordinated manner.

Figure 2. Providing scaffolding during discussion on the use of GeoGebra

Blum and Ferri (2009) emphasize the important role of the teacher in mathematical modeling instruction, which is to maintain a balance between providing support and fostering student autonomy. Effective teaching requires the teacher to provide necessary guidance while allowing students the space to develop their own abilities. This aligns with the Montessori principle, "Help me to do it myself." This balance becomes crucial when students face complex modeling tasks, as they require a combination of appropriate direction and the opportunity to think and solve problems independently.

Observations showed that assistance through GeoGebra illustrations helped students understand the solution steps and visualize the boom crane's movement; however, this support still needs to be limited so that the discovery and knowledge construction processes occur independently. GeoGebra, as a Dynamic Geometry Software (DGS), enables the simultaneous integration of algebraic, geometric, graphical, and numerical representations (Greefrath & Siller, 2018), allowing students to manipulate parameters and observe their impact directly. Previous research indicates that the use of GeoGebra can enhance representational ability, spatial reasoning, and learning interest (Pasco & Roble, 2020; Rabi et al., 2021). In the context of modeling,

GeoGebra functions as a digital environment that supports the mathematization and validation processes through visualization and interactive simulation. It thus serves as an effective medium for exploratory, reflective, and constructivist learning that aligns with the principles of student-centered learning.

3.3. Assessment Results of Student Modeling Tasks

The assessment rubric for the modeling task in this study is based on the modeling assessment rubric designed by Garfunkel & Montgomery (2019) in GAIMME, which evaluates all criteria across the 7 stages of mathematical modeling. The following is a recapitulation of the assessment results for the boom crane trajectory modeling task in this study.

Figure 3. Scores per Modeling Task Stage

The graph of score attainment by modeling stage shows a pattern that is highly consistent with the results of the in-class process observations. The initial stages, such as Describe and Specify, obtained the highest scores, confirming that students possessed a strong understanding and were capable of accurately identifying important variables. This finding aligns with Borromeo Ferri (2018), who stated that students are generally stronger in the initial phases of modeling, which involve understanding the context and simplifying real-world situations. The Formulate stage also showed good mathematical representation ability, consistent with the research by Kaiser & Sriraman (2006), which emphasized that the ability to establish relationships between variables is a crucial foundation in the transition from the context to the mathematical mode.

Conversely, the declining scores in the Solve, Interpret, and Evaluate stages reaffirm the challenges previously identified during in-class observations. In these stages, students often experienced difficulties in performing advanced calculations, interpreting simulation results, and evaluating the model's suitability. This pattern is consistent with the research by Maaß (2010), which found that students' abilities in the intermediate and final modeling stages are often weaker, as they necessitate higher-order mathematical reasoning and critical reflection.

The low attainment in the evaluation stage supports the findings of Ikeda & Stephens (2017) that students tend to accept model results without checking their

assumptions and validity. Meanwhile, the relatively high score in the Report stage indicates that students' mathematical communication skills have developed well, as affirmed by Hoyles & Noss (2015) that technology-based environments like GeoGebra can enhance the quality of mathematical representation and communication.

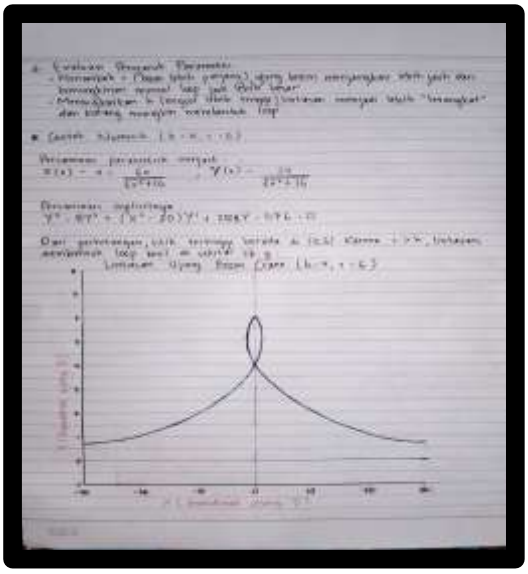

Figure 4. Sample of Student Modeling Task Answers

The correspondence between the modeling task results and the process observation results reveals a consistent pattern: students excelled in the conceptual and representational stages (Describe, Specify, Formulate), but required reinforcement in the analytical and reflective stages (Solve, Interpret, Evaluate). This consistency reinforces Kaiser's (2017) conclusion that modeling success relies heavily on students' ability to integrate mathematical procedures with contextual reasoning—two aspects that often develop unevenly. Thus, the findings of this study not only demonstrate student attainment but also affirm the need for learning interventions that are more directed toward strengthening the analytical, evaluative, and reflective processes in mathematical modeling.

3.4. Development of HOTS Skills and 21st-century Competencies (4C)

This rubric was used to assess students' higher-order thinking skills (HOTS), spatial abilities, and collaboration and communication skills during and after the modeling activities. The following is a recapitulation of the results from this study.

Table 3. Observation Results of Students' HOTS Skills and 4C Competencies

No	Aspect	Average
1	Critical thinking	71,15%
2	Creativity	73,08%
3	Spatial reasoning	67,31%
4	Collaboration	84,62%
5	Communication	82,69%
	Overall	**75,77%**

The HOTS and 4C assessment results indicate that students' Critical Thinking ability is in the 'good' category (71.15%), although the aspects of assumption evaluation and model validation still require reinforcement. This aligns with the findings of Ikeda & Stephens (2017), who highlighted weaknesses in re-testing and variable analysis in modeling. Creativity (73.08%) is also categorized as good, evident from the variety of strategies and model representations constructed by the students, which is in line with Borromeo Ferri (2018) and Hoyles & Noss (2015) regarding the role of technology in facilitating creative exploration. Meanwhile, Spatial Reasoning (67.31%) is in the 'moderate' category, indicating that students still experienced difficulties with complex spatial representations.

In the aspect of collaboration, students demonstrated excellent performance (84.62%), supporting the findings of Kemple et al. (2016) that structured group work enhances understanding and mathematical arguments. Communication was also high (82.69%), evident from the clarity of the presentations and visual representations delivered, consistent with the findings of Hoyles & Noss (2010) regarding the importance of mathematical communication and the role of visual technology. Overall, these findings indicate that the integration of technology-assisted modeling can strengthen students' HOTS and 4C, particularly in creativity, communication, and collaboration, although the aspects of analysis and model validation still require improvement.

3.5. A Scaffolding-Based Modeling Task Design Model: Construction of Stages and Guiding Questions

The design of the boom crane trajectory modeling task was developed using a scaffolding approach to provide graduated support for understanding the context and constructing the model independently. This approach aligns with the findings of Sugiati et al. (2021), who emphasized the effectiveness of scaffolding through guiding questions and concept review when students encounter conceptual barriers. The principles of Explaining, Reviewing, and Restructuring, as well as Developing Conceptual Thinking, were used as the basis for structuring the tiered question stages in the Boom Crane task, guiding students from reading the physical situation and identifying variables to constructing simple geometric relationships. This design also integrates the four-step solution plan from Siller et al. (2023), which affirms the importance of support at each modeling step, as well as during the inter-step transitions, through sequential questions that guide students from understanding the context to evaluating the model's suitability with the physical phenomenon.

The effectiveness of this scaffolding model is supported by the findings of Sofiatun et al. (2018), which showed that scaffolding significantly improves mathematical reasoning abilities, as well as by Nuryadi et al. (2018), who demonstrated

that the "scaffolding with a solution plan" strategy yielded good modeling abilities in high school students. The consistency of these results reinforces the relevance of using scaffolding in the Boom Crane task, where graduated support through questions helped students understand the task context with greater confidence. Thus, scaffolding serves as an effective bridge connecting real-world contexts with students' mathematical abilities in the modeling process.

4. CONCLUSION

This study indicates that the mathematical modeling task based on the Boom Crane context, integrated with GeoGebra and scaffolding support, can improve the quality of geometry learning. The developed task was found to be valid and practical and assisted students in navigating the modeling process from understanding the context to evaluating the model. Students were able to establish relationships between variables, construct accurate visual representations, and perform digital simulations, although the aspects of mathematical problem solving and model evaluation still require reinforcement. Scaffolding played an important role in clarifying thinking processes, guiding modeling strategies, and reducing conceptual barriers, aligning with previous research findings.

In addition to enhancing cognitive attainment, this modeling activity also contributes to the development of 21st-century competencies, especially HOTS, collaboration, communication, and creativity. Students were able to collaborate in simplifying the phenomenon, developing models, and presenting their results in a clear and communicative manner. Therefore, context-based modeling instruction is recommended to be systematically integrated into mathematics learning with the support of scaffolding and technology such as GeoGebra. Further research could explore other modeling contexts and variations in scaffolding strategies to expand the contribution of mathematical modeling in education.

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Mapping Key Aspects for A Critical Thinking-Integrated B1 Reading Curriculum in French Language Learning

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ABSTRACT

The role of critical thinking in foreign language curricula remains underdeveloped, particularly in B1-level reading instruction for French as a Foreign Language in non-Francophone higher education contexts. Although critical thinking is frequently stated as a curricular goal, it is rarely operationalized in instructional practices, while assessment continues to prioritize linguistic accuracy over reasoning quality. This study aims to map key aspects required for designing a CEFR-aligned B1 reading curriculum that explicitly integrates critical thinking for Indonesian university students. A descriptive research design was employed, primarily based on a student needs-analysis questionnaire, complemented by document analysis of CEFR/CECRL descriptors, relevant pedagogical literature, and brief instructor interviews. Quantitative data were analysed using descriptive statistics, while qualitative data supported interpretation through thematic analysis. The findings identify four interrelated curriculum aspects: alignment of B1 reading outcomes with critical-thinking skills, selection of authentic and culturally relevant texts, use of inquiry and reasoning-oriented learning strategies, and assessment practices that integrate comprehension and critical-thinking performance. This mapping provides a context-responsive foundation for B1 reading curriculum development in non-Francophone contexts.

Keywords: *B1 reading, CEFR/CECRL, critical thinking, curriculum design, French as a foreign language.*

1. INTRODUCTION

Reading comprehension at the CEFR B1 level represents a critical stage in proficiency-oriented language education. At this level, learners are required to move beyond the identification of explicit information toward interpreting perspectives, recognizing argumentative patterns, and constructing meaning through the relationships among ideas in a text (Council of Europe, 2020). In non-Francophone contexts such as Indonesia, the attainment of these competencies presents substantial challenges. University learners generally encounter limited exposure to authentic French input beyond formal instruction, rely predominantly on memorization-based learning strategies, and display uneven development of critical reading abilities (Andriani et al., 2022; Miqawati et al., 2023). These contextual constraints significantly influence the development of foreign language literacy and raise critical concerns regarding curriculum relevance and instructional practice.

Aligned with Taba's (1962) assertion that curriculum design should be grounded in a systematic diagnosis of learner needs, recent studies reveal pronounced

discrepancies between CEFR B1 reading requirements and the instructional realities faced in Indonesian higher education. Research across Southeast Asia points to inconsistent implementation of intermediate CEFR descriptors, particularly those related to inferential and evaluative reading skills in contexts characterized by limited language exposure (Yusupalieva, 2024). Such discrepancies are further exacerbated by entrenched pedagogical traditions that emphasize surface level comprehension rather than deeper analytical engagement with texts.

Concurrently, developments in foreign language pedagogy increasingly underscore the integration of critical thinking (CT) within curriculum planning. Conceptualized as the ability to analyze, evaluate, and synthesize information through reasoned judgment (Ennis, 2018; Irfan et al., 2025), CT supports both linguistic proficiency and academic literacy. Nevertheless, critical thinking frequently remains an implicit curricular ideal rather than an explicitly articulated instructional objective (Dhari et al., 2025; Saleh, 2019). This situation reflects the type of curricular misalignment described by Tyler (1949), wherein stated objectives fail to materialize in instructional practices or assessment systems capable of fostering higher-order reasoning.

The Indonesian higher education context amplifies these concerns. Students frequently struggle to distinguish facts from opinions, demonstrate limited habits of source verification, and encounter relatively few culturally relevant authentic texts (Ilyas & Istaryatiningtias, 2025; Renandya & Jacobs, 2016). At the same time, empirical studies on authentic-text modules, project-based tasks, and guided reasoning activities indicate promising potential for enhancing critical reading engagement among intermediate learners (Kuek & Eng, 2025; Tsang & Lam, 2024). Together, these findings represent the current state of the art, suggesting that contemporary B1 reading curricula should be CEFR-aligned, context-responsive, and explicitly oriented toward the development of critical thinking competencies.

Despite these advances, empirical research that systematically connects learner needs diagnosis with curriculum objectives, content selection, learning experiences, and assessment design for CEFR B1 reading in low-exposure contexts remains limited (Council of Europe, 2020; Butler, 2011; Yusupalieva, 2024). In Indonesian higher education, critical thinking is still predominantly articulated as a broad curricular aspiration rather than explicitly operationalized through instructional tasks and assessment practices (Saleh, 2019; Dhari et al., 2025). Consequently, context-responsive B1 reading curriculum models that coherently align CEFR competencies with critical thinking development through established frameworks such as those proposed by Taba (1962) and Tyler (1949) are largely absent.

Consistent with Taba's needs-based curriculum framework, the present study conducted a learner-centered diagnostic involving over 80 university students, complemented by interviews with instructors. Analysis of the data revealed convergent

patterns across cognitive reading skills, contextual relevance of learning materials, learning strategies, assessment expectations, and broader learner needs, pointing to a pressing need for a fundamental rethinking of B1 reading instruction. Accordingly, guided by Tyler's principle of curricular alignment and Taba's inductive model, this study seeks to map the key aspects required for a CEFR-aligned, critical thinking-integrated B1 reading curriculum in french language learning.

2. METHODOLOGY

This study employed a descriptive research design primarily grounded in quantitative needs analysis survey data, with qualitative input used to support interpretation and triangulation. This approach is consistent with Taba's (1962) view that curriculum development should begin with a systematic diagnosis of learner needs, while also reflecting Tyler's (1949) emphasis on using empirical evidence to inform curricular decisions. By prioritizing quantitative patterns and complementing them with qualitative insights, the study aimed to generate a comprehensive and context-sensitive mapping of the competencies required for integrating critical thinking into B1-level reading instruction (Brown, 2021; Richards, 2017)

3.1. Research Design

The study adopted a descriptive, quantitatively driven research design. Quantitative data from a structured needs-analysis questionnaire constituted the primary analytical basis for identifying key aspects of B1 reading curriculum requirements. Qualitative data derived from open-ended questionnaire responses and instructor interviews were employed to contextualize, elaborate, and triangulate the quantitative findings. This design aligns with Taba's (1962) needs-based curriculum model, in which curriculum reconstruction begins with diagnosing learner needs and contextual realities.

3.2. Participants of the Study

A total of 101 students from French-language departments participated in the needs-analysis survey, with 84–86 valid responses recorded for each questionnaire component. All participants were enrolled in courses targeting CEFR B1-level reading competence. In addition, semi-structured interviews were conducted with instructors responsible for teaching reading and related language skills to obtain complementary perspectives on curriculum implementation, instructional practices, and alignment challenges.

3.3. Instruments

Data were collected using two instruments. First, a structured needs-analysis questionnaire was developed based on CEFR B1 reading descriptors, critical-reading

constructs (Ennis, 2018), and curriculum-alignment principles. The questionnaire comprised five components measured on a four-point Likert scale. Several open-ended items were included to capture additional learner perspectives on reading challenges and instructional expectations. Second, semi-structured interview guidelines were used to explore instructors' views on reading instruction practices, the integration of critical thinking, material selection, and assessment alignment. These interviews were intended to complement student survey data and provide instructional-context insights.

3.4. Data Analysis Techniques

Quantitative questionnaire data were analyzed using descriptive statistics, including means, standard deviations, and minimum–maximum values, to identify patterns of learner needs across curriculum aspects. Statistical processing was conducted using SPSS to support systematic interpretation of the findings.

Qualitative data from open-ended responses and instructor interviews were analyzed using thematic analysis, following Braun and Clarke's (2006, 2021) reflexive thematic analysis procedures. The analysis focused on elaborating and validating quantitative trends related to cognitive reading skills, contextual relevance, learning strategies, and assessment expectations. Triangulation across data sources enhanced the credibility of the findings, in line with Tyler's (1949) principle of aligning multiple forms of evidence in curriculum evaluation.

3. RESULTS AND DISCUSSION

The results of the learner needs analysis indicate a consistent pattern across all aspects of B1 reading instruction. As summarized in Table 1, students reported high levels of need in all five aspects, with mean scores above 3.00 on a four-point Likert scale. This overall trend suggests that learners expect reading instruction to move beyond literal comprehension toward more analytical, interpretive, and evaluative engagement.

Table 1. Summary of Learner Needs

Aspect	Mean	Std. Dev
Cognitive Reading Skills	3.33	0.55
Contextual Relevance of Texts	3.22	0.57
Learning Strategies	3.21	0.60
Assessment Expectations	3.26	0.52
Learner Expectations	3.24	0.56

Scale 1=not needed, 4 = highly needed

The highest mean score was observed in the aspect of cognitive reading skills (M=3.33), indicating a strong need for explicit support in inferential comprehension, argument identification, and the interpretation of relationships between ideas. These competencies correspond directly to CEFR B1 reading descriptors, which emphasize understanding viewpoints, tracking arguments, and recognizing textual coherence (Council of Europe, 2020). The findings therefore demonstrate a clear alignment between learners' perceived needs and CEFR-based expectations, while simultaneously revealing gaps in current instructional practice.

Contextual relevance of reading materials also received a high mean score (M=3.22), reflecting learners' preference for authentic, contemporary, and culturally meaningful texts. Given the limited exposure to French outside the classroom in Indonesian higher-education contexts, this result highlights the importance of selecting texts that support not only linguistic comprehension but also sociocultural interpretation. Such findings reinforce the view that reading development is strengthened when texts are embedded in authentic discourse contexts.

In terms of learning strategies, students expressed strong expectations for inquiry-oriented and reasoning-based activities (M = 3.21). This suggests readiness for pedagogical approaches that involve discussion, guided interpretation, and collaborative meaning-making. Rather than favoring simplified instruction, learners appear prepared to engage in cognitively demanding tasks that require justification, evaluation, and reflection.

Assessment expectations similarly point toward the need for curricular reform. The high mean score for this aspect (M = 3.26) indicates a preference for assessment formats that evaluate reasoning processes, such as argument analysis and interpretive responses, rather than tasks focused solely on factual recall. This finding underscores the importance of aligning assessment practices with instructional objectives and CEFR-oriented learning outcomes.

Finally, learner expectations regarding overall curriculum alignment and task difficulty were also high (M = 3.24), suggesting strong awareness of CEFR standards and a desire for more challenging reading instruction. Taken together, these results address the study's objective of identifying key aspects required for a CEFR-aligned, critical-thinking-integrated B1 reading curriculum. The consistent patterns across all aspects provide an empirical basis for proposing a context-responsive curriculum framework grounded in learner needs and contemporary curriculum theory.

While the results demonstrate clear patterns in learners' perceived needs across key aspects of B1 reading instruction, these findings require further interpretation to understand their curricular significance. The following discussion situates the empirical results within CEFR-based reading theory, critical-thinking pedagogy, and curriculum

development frameworks, to explain why these needs emerge and how they inform the design of a context-responsive B1 reading curriculum.

The findings of this study highlight a persistent perceived misalignment between CEFR-based reading expectations and instructional practices in Indonesian higher education. Although CEFR B1 descriptors emphasize inferential comprehension, viewpoint recognition, and coherence interpretation (Council of Europe, 2020), the consistently high learner needs reported in this study suggest that such competencies are not yet systematically developed through existing curricula. Within a needs-analysis framework, learners' self-reported perceptions constitute a valid basis for curriculum diagnosis, as they reflect experiential engagement with instructional practices and curricular demands (Brown, 2016; Richards, 2017). These findings corroborate previous research indicating that intermediate-level reading instruction in low-exposure contexts remains largely dominated by literal comprehension practices (Yusupalieva, 2024; Miqawati et al., 2023)

From a curriculum development perspective, the results support Taba's (1962) assertion that effective curriculum design must begin with a diagnosis of learner needs rather than the uncritical adoption of external standards. The strong demand for cognitive and inferential skill development indicates that current B1 reading syllabi have not sufficiently translated CEFR objectives into concrete learning experiences. In Tyler's (1949) terms, this reflects a breakdown in alignment between stated objectives, instructional activities, and assessment practices.

The importance attributed to contextual relevance further underscores the role of sociocultural factors in foreign-language reading development. Learners' preference for authentic, contemporary, and culturally meaningful texts points to the need to bridge the gap between classroom materials and real-world discourse, particularly in environments with limited access to the target language. This finding aligns with Macalister's and Nation's (2019) view that curriculum content should be systematically informed by learners' environmental conditions, institutional constraints, and future language-use needs.

Learners' expectations regarding learning strategies and assessment provide additional insight into pedagogical readiness. The preference for inquiry-oriented activities and reasoning-based assessment formats suggests that students are prepared for more cognitively demanding forms of instruction, even if such approaches are not yet consistently implemented. This challenges deficit-oriented assumptions about learners in non-Francophone contexts and reinforces the pedagogical value of explicitly integrating critical-thinking instruction into B1 reading courses (Ennis, 2018; Al-Nofaie, 2013).

Taken together, these findings indicate that the central issue is not a lack of learner capacity, but rather a curricular structure that insufficiently supports the

development of higher-order reading skills. Recent scholarship conceptualizes curriculum as a dynamic, adaptive, and context-responsive system that must continuously negotiate learner needs, institutional conditions, and evolving societal demands (Biesta, 2020; Priestley et al., 2021). Within this perspective, effective curriculum frameworks are expected to align intended learning outcomes, instructional practices, and assessment formats in ways that are sensitive to learners' environments and future language-use needs (Macalister & Nation, 2019; Priestley & Philippou, 2024). Such a flexible and responsive approach provides a principled basis for redesigning CEFR-aligned B1 reading curricula that not only address linguistic competence but also foster critical engagement and interpretive competence in non-Francophone higher-education contexts.

4. CONCLUSION

This study mapped key aspects required for the development of a CEFR-aligned B1 reading curriculum that explicitly integrates critical-thinking competencies within the context of Indonesian higher education. Drawing on a quantitatively driven needs analysis supported by qualitative insights, the findings demonstrate that effective curriculum design in low-exposure environments must be grounded in a systematic diagnosis of learner needs and contextual realities, in line with Taba's (1962) inductive curriculum framework. Learners reported consistently high needs across core dimensions, including inferential and analytical reading skills, the use of authentic and socioculturally relevant texts, inquiry-oriented learning strategies, and assessment practices that evaluate reasoning processes rather than factual recall.

The findings further reveal a perceived misalignment between CEFR-based learning objectives and existing instructional and assessment practices, reinforcing Tyler's (1949) principle that curriculum effectiveness depends on coherence among objectives, learning experiences, and evaluation procedures. In response to this gap, the study proposes a context-responsive curriculum framework that aligns CEFR B1 reading competencies with critical-thinking development through needs-based design and curricular alignment principles. While the study does not evaluate instructional outcomes, the proposed framework provides a principled foundation for course-level and institutional curriculum redesign aimed at strengthening critical reading engagement in non-Francophone higher-education contexts.

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Bridging Academic Learning to Workplace Skills: Lectures' Perspective to The Role of The Teaching Campus Program in Higher Education

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ABSTRACT

Against the backdrop of declining literacy and numeracy performance among Indonesian students, as reflected in recent PISA results and exacerbated by learning loss during the COVID-19 pandemic, the Kampus Mengajar (KM) Program was introduced as one of the key initiatives under the Merdeka Belajar–Kampus Merdeka (MBKM) framework to strengthen literacy and numeracy competencies in educational institutions. This study aims to analyze the level of alignment between the implementation of the KM Program and the Learning Outcomes (CPL) of the Physics Education Study Program. The research employed a qualitative method with a case study approach, conducted at a private university in Garut Regency, West Java. The research subjects consisted of four lecturers from the Physics Education Study Program who were purposively selected. Data were collected through structured interviews using a validated interview guide. The findings indicate that although the KM Program aligns with several learning outcomes, certain aspects require adjustment to strengthen its relevance to the scientific context of physics education. Key findings highlight the need for: (1) preparatory training tailored to the specific needs of the Physics Education Study Program, and (2) Focus Group Discussions (FGD) to harmonize perceptions regarding additional assignments and standardized assessment rubrics. The implications of this study underscore the importance of collaboration between KM program implementers and academic programs to optimize the program's impact on the academic and pedagogical competencies of Physics Education students.

Keywords: *MBKM, Physics Education, Program Kampus Mengajar.*

1. INTRODUCTION

PISA 2022 specifically defines mathematical literacy as an individual's capacity to think mathematically and to formulate, use, and interpret mathematics in order to solve problems in a variety of real-world contexts (Ambarwati & Ekawati, 2022; Nolka & Sofianopoulou, 2025; Kappassova, et. al., 2025; Truong & Nguyen, 2025). Scientific literacy in PISA 2022 encompasses concepts, procedures, facts, and tools used to describe, explain, and predict phenomena. It enables individuals to understand the role that mathematics plays in the world and to make informed and reasoned judgments and decisions required of constructive, engaged, and reflective citizens in the 21st century (Örnek & Alaam, 2025; Wu, 2025, Yunarti & Amanda, 2022). One of Indonesia's objectives in participating in PISA is to assess students' reading and mathematical

competencies from an early stage (Mala et al., 2023). However, in the 2022 PISA cycle, Indonesia experienced a decline in scores compared to the 2018 results.

The 2022 outcomes were influenced by several factors, one of which was the challenges students encountered during distance learning throughout school closures. During the pandemic, the shift from face-to-face learning to online learning led to educational technology disruption and significant learning loss (Adi, et.al., 2022; Daniel, 2020; Engzell et al., 2021). Most students made little to no significant progress while learning from home, particularly among those from low-income families (Engzell et al., 2021; Katz & Rideout, 2021). Moreover, socio-cultural factors and the socioeconomic status of families also play a significant role in shaping students' reading abilities (Fan & Williams, 2010; Hill & Tyson, 2009; Sengonul, 2022; Vázquez-Cano, et.al., 2020). Other factors include challenges in independent learning at home, as well as teachers' ability to monitor and guide students in online settings and their capacity to use technology effectively.

The low literacy and numeracy skills of Indonesian students were subsequently addressed by the government through an educational policy issued by the Ministry of Education, Culture, Research, and Technology in 2021, which introduced a new system for evaluating and improving educational quality, namely the National Assessment, one of whose key components is the Minimum Competency Assessment (AKM) (Syafriah & Hadi, 2023). In line with findings from the literature, education policy plays a pivotal role in enhancing student literacy and numeracy, particularly within the framework of the Merdeka Curriculum (Kurikulum Merdeka), which emphasizes flexibility, differentiated instruction, and school autonomy. Policies aligned with these core principles have substantial potential to create learning environments conducive to the development of foundational competencies (kartini., et.al., 2025). One of the government's concrete efforts in this direction has been the implementation of curriculum reforms through the Merdeka Belajar initiative, which is applied across all levels of education, from primary schools to higher education institutions.

The Kampus Mengajar Program, as one of the flagship initiatives under the MBKM policy, reflects students' social responsibility in supporting elementary education in both rural and urban contexts, particularly during challenging learning conditions such as those experienced during the COVID-19 pandemic (Apriliani, et.al., 2024; Fuadi & Irdalisa, 2021; Mansyur, et.al., 2024; Suwanti, et.al., 2022; Syah, 2020). The KM Program engages students from various study programs and provides academic recognition equivalent to 20 credits, offering them the opportunity to learn beyond the university environment in order to strengthen their practical skills. Through this program, it is expected that graduates' competencies both soft skills and hard skills will be enhanced, enabling them to become more prepared and relevant to current

demands, as well as to develop into future leaders who are excellent, ethical, and morally grounded (Lhutfi, 2020; Safaringga et al., 2022).

Moreover, the KM Program involves students from various educational backgrounds across universities to assist in teaching and learning processes in schools (Rachman et al., 2021). The KM Program is also designed to support the School Literacy Movement, thereby helping to improve literacy and numeracy in schools with low accreditation levels (Nafi'ah & Hartonoa, 2022; Putra & Supriyatna, 2024; Putri & Astuti, 2022; Rachman et al., 2021). If students' literacy and numeracy skills improve, it is expected to lead to higher performance in the Minimum Competency Assessment, commonly known as AKM (Nafi'ah & Hartonoa, 2022; Rachman et al., 2021). Thus, various efforts have been undertaken by the government to improve students' reading and mathematics skills in Indonesia, ranging from involving Indonesian students in PISA to implementing several breakthroughs through curriculum reforms.

The Kampus Mengajar Program encompasses learning activities across all subjects with a primary focus on literacy and numeracy, technology adaptation, and administrative support for schools. Through these activities, the program provides students with meaningful learning experiences that foster leadership, character development, empathy, and social awareness, while enhancing critical thinking and interdisciplinary collaboration in addressing real-world educational challenges. In this context, students are expected to act as agents of change who inspire school communities, support teachers in sustaining learning processes through the effective use of educational technologies, and assist schools in adapting to digital-based learning environments. Ultimately, the program contributes to national development by strengthening community participation and reinforcing the tangible roles of higher education institutions and students in improving educational quality (Khotimah et al., 2021; Rosita & Damayanti, 2021).

In addition, the program provides students with opportunities to develop leadership, character, empathy, and social awareness, while enhancing critical thinking and collaboration skills through interdisciplinary engagement and real-world problem solving. Ultimately, the Kampus Mengajar Program aims to strengthen the tangible contributions of higher education institutions and students to national development by fostering community participation and improving the effectiveness of learning processes, particularly in emergency and post-pandemic contexts (Anwar, 2021; Khotimah et al., 2021)

In the first cohort of the KM Program, students were placed in elementary schools across Indonesia to assist in teaching and learning activities. The targeted schools were those with a C accreditation rating as well as schools located in remote, disadvantaged, and frontier (3T) areas (Widiansyah & Fitriansyah, 2022). The materials that students were required to prepare included elementary school pedagogy, literacy and numeracy

instruction, ethics and communication in teaching, the Pancasila Student Profile, child protection principles, and others. In the first cohort of the KM Program, the implementation ran smoothly, and the schools showed strong enthusiasm. The activities carried out included teaching and learning processes, technological adaptation in instruction, and assisting teachers in preparing instructional documents. Teaching activities for Grades 4, 5, and 6 were conducted online and supplemented with door-to-door learning, while for Grades 1 and 2, learning was conducted in alternating in-person sessions under strict health protocols. Technological adaptation involved training in the use of WhatsApp, Zoom Meetings, and Google Classroom. Students also assisted teachers in preparing and completing instructional administration, such as developing lesson plans (RPP), creating learning materials, and carrying out evaluation and assessment administration (Hamzah, 2021).

The Kampus Mengajar (KM) Program has made a significant contribution to improving students' literacy, numeracy, and soft skills, as well as supporting learning activities in elementary schools. Based on previous studies Widiyono et al., (2021) dan Shabrina, (2022), this program has successfully integrated the values of the Pancasila Student Profile through activities such as literacy, numeracy, and character education. (Safaringga et al., 2022) and Noerbella, (2022), they also note that the KM Program is capable of increasing students' learning motivation and familiarizing them with technology through AKM simulations. However, several studies highlight weaknesses within the program, such as insufficient coordination between central and local governments (Andriyani et al., 2023), limited infrastructure (Sari et al., 2023), and challenges related to online learning that reduced the program's effectiveness (Safaringga et al., 2022). n addition, although KM contributes to supporting students with special needs (PDBK), Hariyanti et al., (2023) emphasize the need for special assistance teachers to ensure program sustainability. Suyatno et al. (2023) recommend long-term evaluation to determine the continued impact of the Kampus Mengajar Program on the development of teacher professionalism. These findings indicate the importance of thorough preparation for students before joining KM, particularly in pedagogical understanding, technological adaptation, and inclusive approaches aligned with their disciplinary backgrounds.

Previous studies on the Kampus Mengajar Program emphasize the importance of adequate student preparation prior to school placement, particularly in terms of pedagogical competence and technological readiness, as well as the need for long-term evaluation of the program's impact on the professional development of prospective teachers (Suyatno et al., 2023). However, these studies remain largely focused on program implementation and operational effectiveness at the school level, rather than on its academic integration within higher education curricula. Although existing research generally portrays the Kampus Mengajar Program as a policy initiative

that yields positive outcomes for schools and participating students—especially in enhancing literacy, numeracy, and soft skills—there is a noticeable lack of in-depth investigation into the alignment between the substantial credit conversion of the program, study program learning outcomes (CPL), and students' academic readiness. In particular, empirical evidence capturing lecturers' perspectives as key academic stakeholders responsible for curriculum design, credit equivalence, and learning outcome attainment remains scarce, thereby indicating a critical research gap addressed in the present study.

Nevertheless, in-depth studies on KM from the perspective of higher education institutions remain very limited. Previous research has not examined how lecturers serving as Field Supervisors (DPL) interpret the program's relevance to academic curricula, particularly regarding its alignment with the Learning Outcomes (CPL) of study programs. Furthermore, no studies have reviewed the credit conversion process, the alignment of field assignments with course learning outcomes, or the need for discipline-based preparatory training within study programs. Existing research has also not provided insight into how KM supports students' readiness for the teaching profession from the lecturers' standpoint. Drawing on these research gaps, the present study aims to fill this void by analyzing the perceptions of Physics Education lecturers regarding the alignment of the Kampus Mengajar Program with the CPL, its academic relevance, and areas requiring program improvement.

This study is expected to contribute new insights into understanding the relationship between MBKM policies and their implementation at the study program level, an area that has not been widely explored. Specifically, the study aims to: (1) analyze the extent to which the KM Program aligns with the Learning Outcomes (CPL) of the Physics Education Study Program, and (2) identify areas requiring adjustment to ensure that program implementation becomes more relevant to the academic and professional needs of future physics teachers.

2. METHODOLOGY

This study employed a qualitative approach with an intrinsic case study design to gain an in-depth understanding of how lecturers in the Physics Education Study Program interpret the alignment of the Kampus Mengajar (KM) Program with the Learning Outcomes (CPL). This approach was chosen because the phenomenon under investigation is contextual and specific, requiring deep exploration of the experiences and perceptions of participants directly involved in the program's implementation.

The research was conducted within the Physics Education Study Program at a private university in Garut Regency, West Java. Four lecturers participated in the study, selected purposively based on the criteria that they had prior experience as Field Supervisors (DPL) in the KM Program, taught courses potentially eligible for SKS

conversion through KM, and possessed a clear understanding of the curriculum structure and CPL of the Physics Education Study Program. This purposive selection ensured that data were obtained from informants who truly possessed the competence and relevant experience needed for the study's focus.

Data were collected through semi-structured interviews using an interview guide validated by experts in physics education and MBKM policy. Interviews were conducted in person, depending on participant availability, and lasted approximately 30–45 minutes. The semi-structured format allowed the researchers to explore deeper insights when participants provided significant or emerging information related to KM implementation. Interview topics included lecturers' understanding of the Kampus Mengajar Program, alignment of KM activities with CPL, experiences with credit conversion, students' preparatory needs, and recommendations for program improvement.

In addition to interviews, document analysis was conducted on CPL, Course Learning Outcomes (CPMK), MBKM policy documents, and credit conversion guidelines. Document analysis strengthened the interpretation of findings and ensured that results did not rely solely on subjective perspectives from participants.

3. RESULT AND DISCUSSION

The following are the results of interviews conducted with lecturers who have previously been involved in the KM Program.

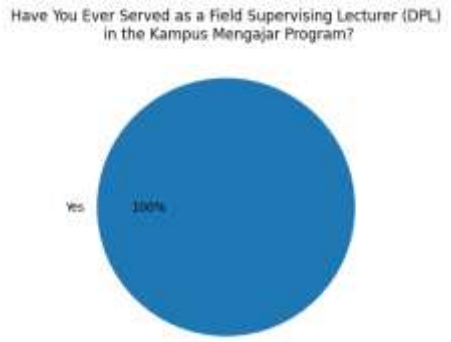

Figure 1. Percentage of Lecturer Participation as Field Supervising Lecturers (DPL) in the Kampus Mengajar Program

Based on the data presented in Figure 1, all respondents (100%) indicated "Yes," confirming that they had previously served as Field Supervising Lecturers (DPL) in the Kampus Mengajar Program. Meanwhile, none of the respondents (0%) answered "No." These results demonstrate that all lecturers participating in the study have had direct experience as DPLs in the Kampus Mengajar Program, ensuring that the interview data obtained are comprehensive and relevant.

Qualitative analysis of the four participants reveals variations in lecturers' involvement across different cohorts of the Kampus Mengajar Program, with the following patterns identified in Figure 2.

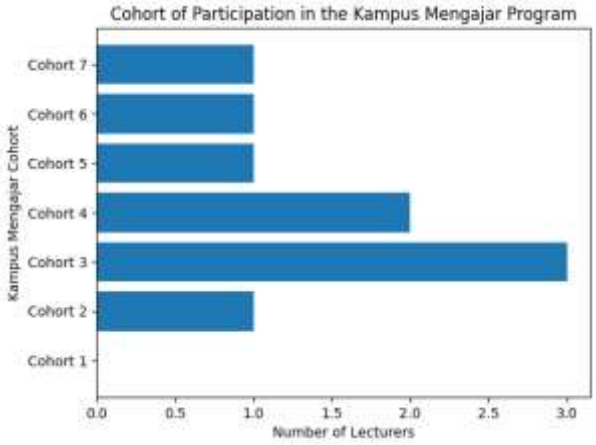

Figure 2. Percentage of Lecturer Participation in the Kampus Mengajar Program by Cohort

Based on the data obtained from the four respondents, a pattern of lecturer involvement across different cohorts of the Kampus Mengajar Program was identified. Cohort 4 showed the highest level of participation, with two lecturers (75% of all respondents), suggesting that this period may have been a significant phase in the program's implementation. Meanwhile, Cohorts 2, 5, 6, and 7 each had one lecturer involved (25% per cohort), indicating a relatively even distribution of participation across several program periods.

The data also reveal that none of the respondents participated in Cohort 1, and no respondent reported having never participated in the program at all. These findings demonstrate that all respondents had direct experience as Field Supervising Lecturers (DPL) in the Kampus Mengajar Program, with varying levels of involvement across different cohorts.

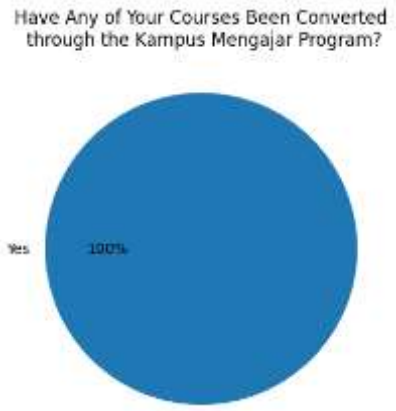

Figure 3. Percentage of Course Conversions within the Kampus Mengajar Program

Based on the data obtained from the four lecturer respondents, it was identified that all respondents (100%) answered "Yes," indicating that the courses they taught

had previously been converted through the Kampus Mengajar Program. Meanwhile, none of the respondents (0%) selected the "No" option.

Based on the follow-up interview data, four courses were identified as having undergone a conversion process within the Kampus Mengajar Program, namely: (1) Physics Learning Planning, (2) Innovation in Physics Learning, (3) Scientific Writing, and (4) History of Physics. This conversion pattern indicates that the program encompasses a comprehensive range of course types, spanning from pedagogical subjects such as Physics Learning Planning to academically oriented courses such as Scientific Writing. The inclusion of Innovation in Physics Learning suggests an emphasis on creativity in teaching, while the inclusion of the History of Physics reflects recognition of the importance of historical foundations within the discipline. The variety of converted courses illustrates an effort to align students' field experiences in the Kampus Mengajar Program with multiple competency domains required in physics education, thereby strengthening the connection between theoretical knowledge acquired in class and practical experiences in the field.

Based on the interview results, the data were analyzed by identifying the main themes that emerged from the lecturers' responses. The lecturers demonstrated a comprehensive understanding of the Merdeka Belajar–Kampus Merdeka (MBKM) policy and the Kampus Mengajar (KM) Program. They recognized the importance of the program in improving literacy and numeracy in low-accredited schools, while also acknowledging its benefits for students' skill development. This understanding reflects the alignment between the program's objectives and the broader vision of national education. However, despite its general relevance, lecturers noted specific concerns regarding aspects of physics as a scientific discipline that have not been fully accommodated within the program.

Lecturers perceived that the Kampus Mengajar Program is largely aligned with the Learning Outcomes (CPL) of the Physics Education Study Program, particularly in terms of general and pedagogical competencies. Nevertheless, they identified several mismatches related to the scientific content of physics, indicating the need for further adjustments. Regarding credit conversion, most lecturers suggested that 10 credits would be a reasonable standard, although they emphasized that this recommendation still requires careful evaluation to ensure equivalence with the workload of formal courses.

Several courses were proposed for conversion, such as Innovation in Physics Learning, Learning Media, and Physics Learning Planning, as these were considered relevant to students' field experiences in the KM Program. To address gaps in learning outcomes, lecturers recommended a variety of additional assignments, including the development of learning media, the preparation of teaching modules, and the writing of scientific articles. These recommendations aim to ensure that students not only gain

practical experience in the field but also continue to fulfill the academic competencies required by the curriculum.

The lecturers agreed that a Focus Group Discussion (FGD) is needed to develop consistent assessment rubrics and to ensure alignment between additional assignments, CPL, and course learning outcomes (CPMK). They also emphasized the need for preparatory training prior to field placement to strengthen students' academic and practical readiness. These findings highlight the importance of collaboration between study programs, lecturers, and MBKM organizers to optimize the benefits of the program while maintaining academic quality. Overall, the analysis underscores the need for continuous alignment between MBKM programs and CPL, as well as stronger coordination through FGDs to ensure consistency in assessment and student preparedness. This is in line with the recommendations of Suyatno et al., (2023) who emphasize the importance of thorough preparation for students before participating in the KM Program, particularly in terms of pedagogical understanding, technological adaptation, and inclusive approaches aligned with their disciplinary background.

The findings show that all lecturer respondents (100%) had experience serving as Field Supervising Lecturers (DPL) in the Kampus Mengajar (KM) Program, with the highest participation occurring in Cohort 3 (75%). The conversion of course credits for subjects such as Physics Learning Planning and Innovation in Physics Learning was considered relevant, although some misalignments were identified in relation to the domain of pure physics. The lecturers agreed that the program is effective in improving students' literacy–numeracy skills and pedagogical competencies; however, they emphasized the need for a Focus Group Discussion (FGD) to develop consistent assessment rubrics, as well as pre-deployment training to ensure alignment between the Learning Outcomes (CPL) and students' field experiences. These findings are in line with the demands of 21st-century learning, which highlight the importance of 4C skills (critical thinking, communication, collaboration, and creativity) and numeracy literacy as foundations for solving contextual problems (Kennedy, & Sundberg, 2020; Thornhill-Miller, et.al., 2023).

The document analysis indicates that several scientific aspects within the Physics Education Study Program have not been fully accommodated through the field activities of the Kampus Mengajar Program. Based on these findings, strengthening through internal study program initiatives is required to ensure optimal alignment between MBKM and the Learning Outcomes (CPL). One program that can be implemented is clinical supervision based preparatory training, which has also been piloted in the student preparation activities for the Kampus Mengajar Program at Universitas Garut. Drawing on the principles of competency-based clinical supervision, such training emphasizes structured practice, direct and formative feedback, needs-based mentoring, and systematic competency development prior to field placement (Hutman et al., 2021).

This preparatory model enables students to enter school settings with more mature pedagogical readiness, clearer professional competencies, and stronger academic coherence.

Extending this perspective, Viscu et al. (2023) emphasize that competency-based supervision frameworks provide a robust mechanism for aligning learning outcomes, training activities, and assessment practices within professional education. A key strength of this approach lies in its explicit mapping of competencies, which enables educational programs to clearly define expected learning outcomes and ensure that experiential learning contributes meaningfully to their achievement. Competency-based preparatory training promotes structured practice, guided reflection, and continuous formative assessment, allowing supervisors to systematically monitor students' progress and provide targeted feedback. In the context of the Kampus Mengajar Program, this framework is particularly relevant for addressing potential misalignments between study program learning outcomes (CPL), substantial credit conversion, and students' pedagogical readiness, thereby strengthening academic accountability and pedagogical coherence in field-based learning.

Through such preparatory training, students not only gain an understanding of the administrative requirements of the Kampus Mengajar Program but also develop deeper insights into the context of physics learning, including the design of instructional materials, the selection of relevant learning media, and the application of literacy and numeracy strategies grounded in science content. To further support this process, study programs may incorporate school-based physics microteaching, workshops on developing teaching modules, and structured credit-conversion guidance sessions to ensure that students' field experiences demonstrate clear equivalence with the Learning Outcomes (CPL) and Course Learning Outcomes (CPMK). Accordingly, a preparatory model grounded in competency-based clinical supervision serves as a strategic mechanism to bridge the objectives of the MBKM policy with the competency requirements of graduates in the Physics Education Study Program, ensuring that field-based experiences are pedagogically meaningful and academically aligned.

Twenty-first-century learning is structured as an effort to prepare the current generation to adapt to rapid technological advancement and the evolving information systems that shape modern society. The Partnership for 21st Century Learning (P21) (2019) states that core knowledge for learners, from elementary to higher education, must be integrated with skill-based learning to ensure success in today's world. Furthermore, P21 emphasizes that 21st-century learning requires mastery of the 4C learning skills: critical thinking, communication, collaboration, and creativity (Nurhayati, Asrin & Dewi1, 2022; So-Arianne-Mae, et.al., 2021). The requirements of 21st-century learning emphasize critical thinking skills, the ability to connect knowledge with real-world contexts, proficiency in information technology, as well as effective

communication and collaboration. These skill demands can only be realized when learners possess strong numeracy competencies (AlAli, 2024; Kalyani, 2024).

Efforts to improve students' literacy and numeracy skills carried out by university students in the Kampus Mengajar (KM) Program not only have a positive impact on pupils' academic abilities but also contribute significantly to the development of the students' own soft skills. Through direct field experience, participating students are trained to face various challenges in the learning process, such as adapting to learners with diverse backgrounds and solving problems that arise during interactions with students and teachers (Nguyen, 2022; Purike & Aslan, 2025; Wulandari et al., 2023; Yang, 2024).

In addition, students refine their communication, teamwork, problem-solving, and leadership skills as they collaborate with school stakeholders and fellow university participants. The KM Program provides opportunities for students to apply theoretical knowledge learned in the classroom to real-world practice, thereby enhancing their confidence and their ability to interact and collaborate in professional settings. Thus, beyond improving pupils' literacy and numeracy, the Kampus Mengajar Program also plays a crucial role in developing essential non-technical competencies needed in social life and the 21st-century workplace.

4. CONCLUSION

This study concludes that the Kampus Mengajar (KM) Program has provided substantial benefits by integrating field experiences with academic learning, particularly in strengthening students' pedagogical skills, literacy–numeracy competencies, and professional readiness. All lecturer respondents demonstrated direct experience as Field Supervising Lecturers (DPL), enabling comprehensive and context-rich insights into the program's implementation. The findings reveal that while the KM Program aligns with several Learning Outcomes (CPL) of the Physics Education Study Program—especially in general and pedagogical competencies—there remain gaps in accommodating discipline-specific scientific content in physics.

Course credit conversions for subjects such as Physics Learning Planning and Innovation in Physics Learning were considered relevant, yet the need for clearer equivalence between field activities and academic workloads persists. Lecturers emphasized the importance of structured pre-deployment training, particularly in pedagogical preparation, technological adaptation, and inclusive approaches, to ensure that students possess adequate readiness before entering the field.

Furthermore, the study highlights the necessity of conducting Focus Group Discussions (FGD) to develop standardized assessment rubrics and harmonize the expectations between study programs and KM organizers. Strengthening internal program initiatives—such as clinical supervision–based preparation, physics-oriented

microteaching, and workshops on teaching material development—can enhance alignment between MBKM initiatives and academic requirements.

Overall, the KM Program holds strong potential to address 21st-century learning demands by fostering 4C skills (critical thinking, communication, collaboration, and creativity) and enhancing literacy–numeracy capabilities. However, its continued effectiveness relies on systematic collaboration, curricular alignment, and continuous refinement to ensure that field experiences meaningfully contribute to achieving the competencies required of future physics teachers.

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Unveiling Teachers' Intentions to Implement Gender-Responsive Classroom Management Using the Theory of Planned Behaviour: The Basis of Teacher Empowerment Policy

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ABSTRACT

Implementing gender-responsive classroom management is crucial for teachers to create an inclusive and equitable learning environment for all students. Although teacher empowerment on gender-based classroom management has been implemented through training, it is often hampered and less sustainable if it is not supported by teachers' intentions to implement it. This study examines the impact of attitudes, behavioral control, and subjective norms on teachers' intentions to adopt gender-responsive classroom management practices. The study employed a survey method, involving a sample of 60 elementary school teachers in Sukabumi Regency. Data were collected through questionnaires designed based on the Theory of Planned Behaviour (TPB) to measure intentions, attitudes, subjective norms, and perceived behavioral control. Data analysis was carried out using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results showed that positive attitudes and perceived behavioral control had a significant impact on teachers' intentions, with path coefficients of 0.297 and 0.337, respectively ($p < 0.001$). Meanwhile, subjective norms do not significantly affect the teacher's intention. These findings confirm the importance of perceived behavioral control as a key factor in encouraging teachers to adopt gender-responsive classroom management practices. This research provides policymakers with insights to develop effective intervention strategies that support teacher empowerment and promote gender-responsive and inclusive classroom management practices. Therefore, it is recommended that teacher empowerment policies focus on providing adequate training and creating a supportive environment to improve teachers' intentions and abilities in implementing gender-responsive classroom management.

Keywords: *gender-responsive classroom management, perceived behavioral control, teacher empowerment, teachers' intentions, the Theory of Planned Behavior (TPB).*

1. INTRODUCTION

The implementation of gender-responsive classroom management provides opportunities for all students to be treated equally and to respect one another (Aafaf et al., 2025; Miralles-Cardona et al., 2025). Gender-responsive classroom management also meets students' academic, social, and emotional needs, which supports long-term educational development. Integrating gender responsiveness in classroom management is crucial for achieving the goals of sustainable development, as a holistic approach can significantly enhance gender inclusion in education (Bustamante-Mora et al., 2024; Pailman & De Groot, 2021).

While the positive impact and importance of implementing gender-responsive classroom management have been recognized, many factors that affect teachers' intentions and ability to implement this approach have not been fully explored. Teacher empowerment through training, although frequently carried out, is often constrained by unsustainable factors if it is not supported by the teacher's intention to implement new innovations received through training. Factors that affect teachers' intentions to implement gender-responsive management include teacher resistance, lack of training, and other contextual barriers, such as the school environment or context, that prevent teachers from implementing gender-responsive classroom management. These three factors are supported by the results of previous research, which challenges include resistance from teachers, a lack of training, and contextual barriers that hinder the implementation of gender-responsive and inclusive classroom management (Bustamante-Mora et al., 2025). This indicates a gap in the internal (attitude) and external (behavioral control and subjective norms) obstacles that teachers face in implementing effective gender-responsive classroom management.

The Theory of Planned Behaviour (TPB) offers a relevant framework for analyzing teacher resistance in relation to the teacher's intention. By considering teachers' attitudes, subjective norms, and behavioral controls, TPB helps explain the barriers behind teachers' decisions in managing gender-responsive classrooms. This study seeks to uncover the factors of teachers' intentions to implement gender-responsive classroom management reviewed from the TPB. The primary objective of this study was to identify the factors that influence primary school teachers' intention to implement gender responsiveness in the management of inclusive classrooms. The results of the research will contribute to the formulation of more effective intervention strategies and support the improvement of gender-responsive and inclusive classroom management practices in schools.

2. METHODOLOGY

This study applies a survey method to investigate teachers' intentions in implementing gender-responsive classroom management. The research population consisted of 376 elementary school teachers in Sukabumi Regency. Sampling, using random sampling techniques that ensure each individual has the same chance of being selected (Otzen & Manterola, 2017). Sampling of 60 people, with consideration of a smaller sample size, can accurately estimate parameters (Schillaci & Schillaci, 2022). The data collection process was conducted from March to July 2025, following permission obtained from the Sukabumi Regency Education Office.

The research variable is the intention of teachers to apply gender-responsive classroom management, which will be measured using the Theory of Planned Behaviour (TPB) framework, a theoretical framework that predicts individual behaviour

(Gülsün et al., 2025; Hellmich et al., 2019). The data collection technique, which involved distributing questionnaires to teachers who were willing to participate, consisted of 12 items that measured four dimensions based on the Theory of Planned Behavior (TPB), namely teacher intentions, attitudes, subjective norms, and perceived behavioral control (Table 1). Option answers developed on the Likert scale consist of five categories: always, often, sometimes, rarely, and never.

2.1. Instruments

Table 1. Questionnaire with Applying the Dimensions of TPB Measurement

Teacher Intention	
TI1	I intend to apply a gender perspective in creating an inclusive classroom.
TI2	I plan to integrate gender issues into classroom management
TI3	I am committed to training on gender equality in education
Attitude	
ATT1	I believe in the importance of gender equality in education.
ATT2	I support the implementation of flexible and inclusive gender roles in the classroom.
ATT3	I believe that the implementation of gender responsiveness can increase students' active learning participation
Subjective Norms	
SN1	I consider the support of colleagues and school leaders important for gender mainstreaming
SN2	I believe that parents and society support the implementation of a gender perspective in schools
SN3	I pay attention to the social norms in the school environment that influence my decision to adopt a gender-responsive approach
Perceived Behavior Control	
PBC1	I intend to apply a gender perspective in creating an inclusive classroom
PBC2	I plan to integrate gender issues into classroom management
PBC3	I am committed to training on gender equality in education

The research hypothesis that will be proven consists of three hypotheses. First, there was no influence of perceived behavioral control (PBC) on teachers' intentions to implement gender-responsive classroom management. Second, there was no influence of teachers' attitudes on teachers' intentions to implement gender-responsive classroom management. Additionally, there is no significant influence of the Subjective Norm (SN) on teachers' intentions to implement gender-responsive classroom management.

The data analysis technique employed was Partial Least Squares Structural Equation Modeling (PLS-SEM), using Smart PLS 4.1.1.4 software. The PLS-SEM method was chosen because of its ability to handle smaller sample sizes and provide reliable estimates despite the limited data available. The data analysis technique is complemented by Importance-Performance Map Analysis (IPMA), which serves to evaluate the contribution of each variable to teachers' intentions in implementing

gender-responsive classroom management. Through IPMA, it aims to identify key variables that need to be prioritized in teacher intention interventions to enhance the effectiveness of implementing gender-responsive classroom management.

3. RESULT AND DISCUSSION

The survey data were analyzed using PLS-SEM, with the following processing steps.

3.1 Evaluation Results of the Reflective Measurement Model

The results of data analysis of 60 driving teachers using PLS-SEM began with an evaluation of the reflective measurement model. This analysis aims to evaluate reflective measurement models as the first step in data analysis using PLS-SEM. Reflective measurement models are used to represent theoretically based constructs, and their evaluation criteria are essential to ensure the validity of the results (Hanafiah, 2020; Lub et al., 2025). Reflective measurement models assume that indicators are manifestations of the underlying constructs, and thus, indicators must be correlated. Evaluation of the reflective measurement involves assessing the reliability of internal consistency, convergent validity, and discriminant validity (Hanafiah, 2020; Prasojo et al., 2020). For further clarity, refer to Table 2.

Table 2: Evaluation Results of the Reflective Measurement Model

Construct	Item	Internal Consistency Reliability		Convergent Validity		Discriminant Validity
		Cronbach's Alpha α ≥	Composite Reliability (CR) ≥0,7	Outer Loading	AVE ≥ 0.50 C	
Teacher Intention	TI1	0.88	0.887	0.92	0.806	Yes
	TI2			0.89		
	TI3			0.88		
Attitude	ATT1	0.795	0.865	0.70	0.706	Yes
	ATT2			0.92		
	ATT3			0.89		
Subjective Norms	SN1	0.842	0.858	0.81	0.761	Yes
	SN2			0.92		
	SN3			0.88		
Perceived Behaviour Control	PBC1	0.772	0.818	0.80	0.679	Yes

Table 2 shows that all proposed model constructions meet the criteria of internal consistency, convergent validity, and discriminant validity. The reliability of the internal consistency (Table 2) proves that the results of Alpha (α) and Cronbach's Composite (CR) >are 0.70. Similarly, a Convergent Validity (AVE) > of 0.50 indicates that there is a construction of most variances in the variable indicators. Validity of Discriminant with < criterion 1 as proof that constructions are different from each other (Byon & Jang, 2024; Hanafiah, 2020; Vishnoi et al., 2024). Thus, Table 2 shows that all proposed

model constructions meet the criteria of internal consistency, convergent validity, and discriminant validity. Based on Table 2, a structural model analysis was conducted to illustrate the relationship between the variables studied (Figure 2).

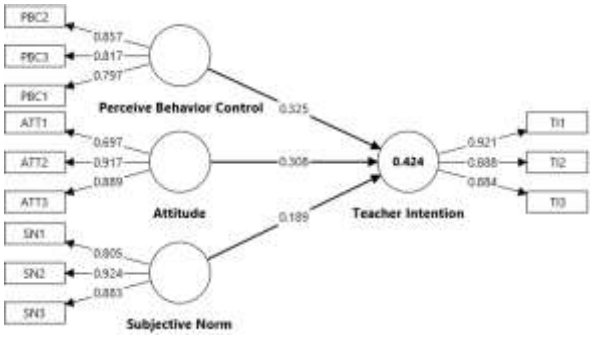

Figure 2: Structural Model Analysis Results

The results of the PLS-SEM analysis, as shown in Figure 2, illustrate the proposed model that explains the factors influencing teachers' intentions to implement gender-responsive classroom management. Thus, Figure 2 serves as a visual representation that clarifies the results of the Evaluation of the Reflective Measurement Model analysis, facilitating an understanding of the interaction between variables in the research. Referring to the structural model analysis (Figure 2), the next step is to conduct the Heterotrait-Monotrait Ratio (HTMT) analysis to evaluate the validity of the discriminant.

Table 3. Analysis HTMT

Construct	Heterotrait-Monotrait	Threshold
PBC⍰ATT	0,629	(Ab Hamid et al., 2017; Aburumman et al., 2023; Benitez et al., 2020; Latif et al., 2025)
SN ⍰ ATT	0,385	
SN ⍰PBC	0,535	
TI ⍰ ATT	0,596	
TI ⍰ PCB	0,646	
TI ⍰ SN	0,483	

Table 3 presents the results of the Heterotrait-Monotrait Ratio (HTMT) analysis used to evaluate the discriminant validity of the constructs in the study. HTMT is a ratio that measures the relationship between different constructs (heterotraits) compared to the same construct (monotrait). A low HTMT value indicates that the construct has good discriminant validity, meaning that the constructs do not overlap significantly with each other.

The HTMT values in Table 3 for the various pairs are all below the set threshold, which is 0.85. The results of the analysis showed that the HTMT value met the criterion. This criterion refers to the opinion that an HTMT value of less than 0.85 indicates adequate discriminant validity (Ab Hamid et al., 2017; Aburumman et al., 2023; Benitez et al., 2020; Ekundayo & Ezugwu, 2025). These results are consistent with the criterion

that HTMT values lower than the threshold indicate that the construct has good discriminant validity.

3.2 PLS-SEM: Evaluation of the Structural Model

The results of the structural model evaluation analysis, using Partial Least Squares Structural Equation Modeling (PLS-SEM), showed the path coefficients and significance of the tested hypotheses (Table 4). This analysis aims to assess the suitability of the proposed model and to measure the strength and direction of the relationship between variables. The results of the analysis also provide important insights into the influence of attitudes, subjective norms, and behavioral control on teachers' intentions in implementing gender-responsive classroom management.

Table 4. Structural Model Evaluation Result

Hypothesis	Path	Coeff Path	T Statistic	p-value	Supported
H1	PBC TI	0.337	3.481	0	Supported
H2	ATT TI	0.297	2.479	0.007	Supported
H3	SN TI	0.208	1.436	0.076	Not Supported

The results of the analysis, as shown in Table 4, evaluate the structural model based on the tested hypothesis. The effect of PBC on IT showed a path coefficient of 0.337 with a T-statistic of 3.481 and a p-value of 0. A significant p-value indicates that the hypothesis is not supported (Fernandez, 2021). In other words, the first hypothesis (H0) that there is no influence of PBC on teachers' intentions is rejected, indicating that the influence of behaviour control felt by teachers has a significant impact on their intentions to implement gender-responsive classroom management (Ha). The influence of Attitude on Teacher Intention has a path coefficient of 0.297, a T-statistic of 2.479, and a p-value of 0.007. These results indicate that the second hypothesis (H0) is not accepted, suggesting that the teacher's attitude does not contribute significantly to the teacher's intention (Ha). The effect of Subjective Norm on Teacher Intention showed a path coefficient of 0.208, with a T-statistic of 1.436 and a p-value of 0.076. Since the p-value does not reach the established significance level (<0.05), the third hypothesis (H0) is supported (Eden & Inan, 2022). In other words, subjective norms have a limited influence on the teacher's intentions.

3.3 Importance Performance Map Analysis (IPMA)

Based on the results of the structural model evaluation, the next step is to estimate the Importance-Performance Map Analysis (IPMA) by construct and the IPMA by indicator. Based on the construction and items, variable areas that need improvement can be identified. The comparison of the importance (horizontal axis) of each construction with its performance (vertical axis) is seen in Figure 3.

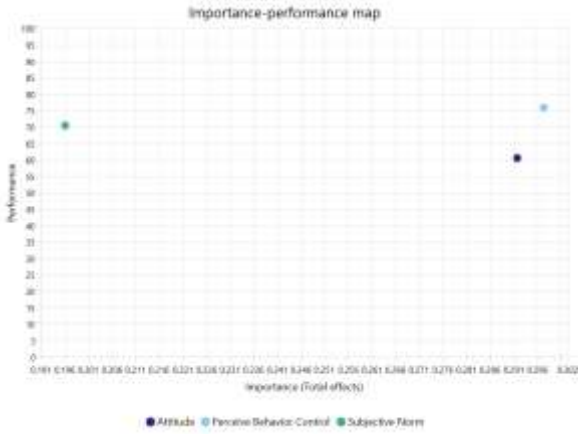

Figure 3. IPMA Results by Construct

In Figure 3, PBC is the most important variable in the model (0.297), as seen from its performance (75.95). The results of this analysis indicate that the PBC variable is a crucial factor that warrants prioritization. Based on the results of the IPMA by construct analysis, the next step is to examine the most important indicators of PBC, followed by the IPMA by indicator analysis (Figure 4).

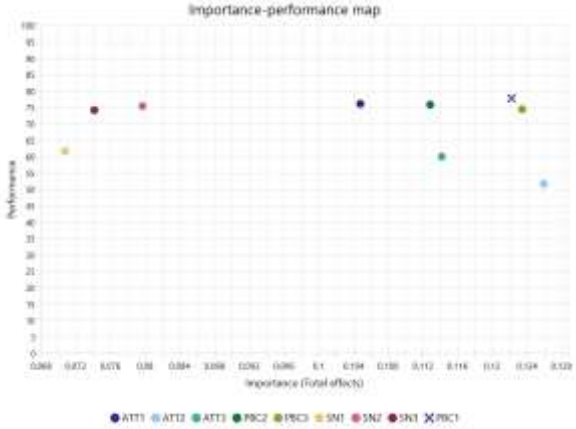

Figure 4. IPMA Results by Indicator

Figure 4 shows that the PBC1 and PBC3 indicators have very high performance values and importance. More clearly displayed in the form of a table (Table 5).

Table 5. Importance Performance Map Analysis

The influence of indicators on IT	Importance	Mean Value (MV) performance
ATT1	0.105	76.11
ATT2	0.126	51.67
ATT3	0.114	60.00
PBC1	0.122	77.78
PBC2	0.113	75.83
PBC2	0.123	74.44
SN1	0.071	61.67

Table 5 presents the results of the Importance-Performance Map Analysis (IPMA) by indicator, which shows the influence of various indicators on teacher intent (IT) and the performance of each indicator. The PBC 1 indicator has the highest importance value of 0.122 and performance (performance) 77.78, showing that the statement "I intend to apply a gender perspective in creating an inclusive classroom" is a very influential indicator and also has good performance. The PBC 2 and PBC 3 indicators also showed significant importance values, at 0.113 and 0.123, respectively, with performance levels of 75.83% and 74.44%. This indicates that the two indicators, "I plan to integrate gender issues in classroom management" and "I am committed to training on gender equality in education," also contribute positively to teachers' intentions to implement gender-responsive classroom management.

Attitude indicators (ATT1, ATT2, ATT3) have varying importance values, with ATT2 having the highest value of 0.126, but with a lower performance of 51.67. This indicates that, although this indicator is important, its performance still needs improvement. The SN (Subjective Norm) indicator showed a lower importance value than the PBC and ATT indicators, with SN1, SN2, and SN3 having importance values of 0.071, 0.080, and 0.074, respectively. The performance of these indicators also varies, but overall has less effect on the teacher's intention. Thus, it can be said that the results of the IPMA analysis in Table 5 indicate that the PBC indicator, especially PBC 1, has a significant impact on the teacher's intention, while other indicators, such as ATT and SN, need more attention to improve their performance.

4. CONCLUSION

This study revealed that positive attitudes and perceived behavioral control had a significant impact on teachers' intentions to implement gender-responsive classroom management, whereas subjective norms did not show a significant influence. The results of the analysis showed that teachers who felt empowered and resourceful were more likely to commit to implementing gender-responsive practices, indicating the importance of institutional support and effective training. Although teachers' positive attitudes contribute to their intentions, social norms are not strong enough to motivate behavior change. These findings offer valuable insights for education policy development, highlighting the importance of providing adequate training and creating a supportive environment for teachers to feel more confident in implementing inclusive and gender-responsive classroom management.

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Integrating Modelling Competence and Pedagogical Readiness of Pre-Service Mathematics Teachers in Implementing Modelling-Based Classroom Learning

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ABSTRACT

Mathematical modelling competence has become a key component of 21st-century mathematics education, emphasizing the ability to connect abstract concepts with real-world contexts. However, teacher education programs in Indonesia still demonstrate limited focus on developing modelling pedagogy. This study aims to assess pre-service mathematics teachers' competencies in mathematical modelling and their pedagogical readiness to implement modelling-based learning in classrooms. The research aligns with the 2025 National Mathematics Curriculum, which positions teachers as facilitators of contextual and future-ready learning. A mixed-method approach was employed, involving mathematics education students from several universities in Indonesia. Data were collected through a diagnostic modelling task and a pedagogical readiness rubric assessing participants' ability to design, guide, and reflect on modelling lessons. Quantitative analysis revealed that participants showed strong conceptual understanding in formulating and solving mathematical models, yet struggled with validation and didactical reasoning. Qualitative findings supported these results, showing varied pedagogical awareness in scaffolding students' modelling processes. The findings highlight a gap between mathematical mastery and pedagogical application in modelling instruction. The study concludes that integrating modelling pedagogy into teacher education curricula is essential to empower future teachers and foster curriculum innovation that supports transformative mathematics learning in the digital era.

Keywords: *curriculum innovation, mathematical modelling, pedagogical readiness, teacher education*

1. INTRODUCTION

Mathematical modeling has become a key element in 21st-century mathematics education due to its ability to bridge abstract concepts with authentic real-world situations. This competency not only demands procedural skills but also conceptual understanding, reasoning, creativity, and pedagogical reflection. Aligned with the transformation of the 2025 National Mathematics Curriculum, teachers are required to act as facilitators who can design contextual learning experiences and encourage students to construct understanding through the modeling process.

However, various studies indicate that the integration of modeling in learning still faces significant challenges in Indonesia. At the teacher education level, the development of modeling competency has not been fully structured within either the curriculum or coursework. As a result, pre-service teachers often only understand modeling from a mathematical standpoint but lack the pedagogical readiness to implement it in an actual classroom context.

Ferri (2018) developed a comprehensive model regarding the competencies required by teachers to effectively implement mathematical modeling instruction. This model consists of four primary interconnected dimensions: (1) the theoretical dimension, (2) the task dimension, (3) the instructional/teaching dimension, and (4) the diagnostic dimension. These four dimensions form a competency framework that teachers must possess to be able to design, facilitate, and evaluate modeling activities in the classroom.

1. The Theoretical Dimension

This dimension emphasizes the conceptual understanding and theoretical foundations of mathematical modeling. Teachers need to understand:

a. The modeling cycle, including the processes of describing phenomena, constructing models, analyzing, interpreting, and validating results.
b. The goals and perspectives of modeling, both as a tool for solving real-world problems and as a means to develop students' mathematical competencies.

2. The Task Dimension

This dimension relates to the teacher's ability to understand, analyze, and select types of modeling tasks that are appropriate for students. This includes:

a. Diverse modeling problems, including open-ended tasks, contextual investigations, and authentic problems.
b. Cognitive analysis of tasks, which involves assessing the cognitive demands, solution steps, and potential difficulties students might encounter.

3. The Instructional/Teaching Dimension

This dimension pertains to the teacher's ability to design and implement modeling instruction. This competency includes:

a. Planning modeling-based instruction, including setting objectives, sequencing activities, selecting contexts, and scaffolding strategies.
b. Implementing modeling instruction, specifically the ability to facilitate discussions, provide minimal yet effective guidance, manage group work dynamics, and support student exploration.

4. The Diagnostic Dimension

This dimension focuses on the teacher's ability to identify students' thinking processes and monitor their progress in modeling. This includes:

a. Identifying the stages of the modeling process, such as where difficulties arise in model formulation, interpretation, or validation.
b. Identifying errors and obstacles, including both mathematical errors and conceptual errors related to the context.

Recent research emphasizes that pedagogical readiness, particularly for complex instruction, encompasses three primary interconnected components: PCK, PDC, and Teacher Noticing (and Reflection).

PCK, first defined by Shulman (1986), is a core foundation for teachers, involving the integration of subject matter (such as mathematics, which is abstract and interconnected) with appropriate pedagogical strategies, thus requiring both content mastery and effective instructional planning. In the context of modeling-based instruction, the PCK of pre-service teachers is manifested through their ability to explain abstract concepts, understand student misconceptions, and select appropriate scaffolding.

PDC refers to the capacity of pre-service teachers to design relevant and authentic learning experiences. Due to the open-ended nature of modeling instruction, PDC is crucial in ensuring that the learning experience is not rigid and can accommodate the various solution pathways that students might take. The core components of PDC required in complex instruction include sequencing of activities, selection of authentic contexts, preparation of dynamic scaffolds, and formative assessment of the process. PDC is also reflected in the general ability of pre-service teachers to develop curriculum frameworks, design syllabi, and create Lesson Plans (RPP) that are grounded in students' critical thinking.

Teacher Noticing is the teacher's ability to attend to students' strategies, difficulties, and thinking patterns during the learning process. This competency is crucial as it determines the quality of interventions that teachers provide while guiding students, particularly in open-ended tasks such as modeling. The noticing framework developed by Jacobs et al. (2010) outlines the development of this competency, wherein teachers must be able to use robust evidence, rather than limited or insufficient evidence, as an indicator for intervention. Noticing enables teachers to identify key moments in student learning and provide timely interventions. Based on this situation, there are several key problems:

1. A gap between mathematical ability and pedagogical readiness in mathematical modeling among pre-service teachers.
2. A lack of training and authentic experience in designing and implementing modeling-based instruction.

3. A lack of comprehensive mapping of pre-service teachers' modeling competencies in Indonesia based on empirical data across universities.

A lack of understanding of how pre-service teachers provide scaffolding for students during the modeling process. These problems indicate an urgent need for a systematic evaluation of pre-service teachers' mathematical modeling competencies as well as their pedagogical readiness.

This study is designed using a mixed-method sequential explanatory approach, thereby providing a comprehensive overview of pre-service teachers' mathematical modeling competencies.

The problem-solving steps include:

1. Collecting quantitative data through a modeling diagnostic task to assess participants' conceptual understanding at each stage of modeling.
2. Analyzing pedagogical readiness using a rubric that assesses the ability to design, guide, and reflect on modeling instruction.
3. Supplementing the data with qualitative analysis through participants' written reflections and documentation of their solution process, in order to capture the depth of their didactic awareness.
4. Synthesizing the quantitative and qualitative findings to map a profile of modeling competencies and identify pedagogical gaps.
5. Generating recommendations for curriculum improvement in teacher education, particularly regarding the integration of modeling pedagogy.

This approach ensures that the research findings are not merely descriptive, but also provide relevant directions for intervention.

This study aims to:

1. Assess the mathematical modeling competencies of pre-service teachers, specifically in the stages of model formulation, solution, interpretation, and validation.
2. Evaluate the pedagogical readiness of pre-service teachers in designing and implementing modeling-based instruction.
3. Identify the gaps between mathematical competencies and pedagogical competencies within the context of modeling.

2. METHODOLOGY

2.1 Research Design

This study uses a mixed-method approach with a sequential explanatory design. This design was chosen to obtain a comprehensive understanding of pre-service teachers' mathematical modeling competencies and pedagogical readiness. In the first phase, quantitative data were collected through a modeling diagnostic task. These quantitative results were analyzed to map participants' conceptual abilities at each

stage of modeling. The second phase consisted of qualitative analysis using pedagogical reflections and an observation rubric to explore the depth of participants' didactic reasoning and the context influencing their performance. The integration of both data types was conducted using a merging and comparing technique, allowing the qualitative findings to explain in greater depth the patterns that emerged from the quantitative results.

2.2 Research Participants

The participants in this study were mathematics education students from several public and private universities in Indonesia. The sampling technique used was purposive sampling, as the selected participants had to meet the following criteria:

1. Enrolled in a mathematics education program (at least in their third semester).
2. Having taken a course related to learning strategies or basic PCK.
3. Willing to participate voluntarily.

The total number of participants in this study was 126 students. From this group, 32 participants were selected to complete the full diagnostic modeling task. The participants were from several universities in Indonesia, which provided a diversity of academic contexts and learning experiences.

2.3 Research Instruments

This study used two primary instruments designed to measure the two main variables: pre-service mathematics teachers' mathematical modelling competence and their pedagogical readiness to implement modelling instruction.

1. Modeling Diagnostic Task

Mathematical Modelling Competence functions as a dependent variable, central to this study's evaluation. It embodies the content-specific competency of pre-service teachers in applying mathematical knowledge to modeling contexts. Mathematical Modelling Competence was measured using a Modeling Diagnostic Task themed "The Trajectory of a Boom Crane Tip." This instrument was developed based on the modeling process framework (Blum & Leiss, 2007) and assessed using a rubric adapted from Garfunkel & Montgomery (2019), which covers the seven stages of modeling: Describe/Understanding, Specifying/Simplifying, Formulating/Mathematizing, Solving, Interpreting, Evaluating/Validating, and Reporting. The task was administered online to 32 participants. Scores were analyzed descriptively (e.g., mean, median) for each stage. Participants' output included calculations, graphs, model justifications, and brief reflections regarding the model's validity.

2. Pedagogical Readiness for Modeling Questionnaire (30 Likert-Scale Items)

Pedagogical Readiness is the second dependent variable, representing the teaching-specific competency required for implementing modeling-based instruction. A pedagogical readiness for modelling questionnaire comprising 30 likert-scale items (ranging from strongly disagree to strongly agree) designed to measure six key aspects: (a) familiarity and initial readiness with modeling, (b) perceptions of lesson plans and learning sequences, (c) perceptions of scaffolding within the task structure, (d) pedagogical reflection and relevance, (e) experience with implementing modeling tasks, and (f) analysis of student readiness and potential conceptual difficulties. The questionnaire data were analyzed descriptively by calculating the mean score for each aspect to profile the participants' perceived readiness.The data from both instruments were then integrated and comparatively analyzed to identify potential gaps between the participants' subject-matter modelling competence and their pedagogical readiness to implement it.

2.4 Data Analysis Techniques

The research data were analyzed using a mixed-method sequential explanatory approach, which sequentially integrated quantitative and qualitative analysis to obtain a comprehensive picture. In the quantitative phase, participants' answers on the modeling diagnostic task were assessed using a five-level rubric for each modeling stage. Participants' scores were analyzed descriptively, calculating the mean, median, standard deviation, and the distribution of proficiency for each stage.

Questionnaire data were analyzed using descriptive statistics to map the pedagogical readiness profile across the six measured aspects. The qualitative phase was conducted through thematic analysis of participants' reflections and their narrative responses on the questionnaire. Integration of both data types was performed using the joint display technique, which involves comparing quantitative and qualitative findings to identify gaps between mathematical competency and pedagogical readiness. These integrated results were used to strengthen the interpretation of the findings and to formulate recommendations for teacher education development.

3. RESULTS AND DISCUSSION

3.1. Assessment Results of the Modeling Diagnostic Task for Pre-service Mathematics Teachers

The following is a recapitulation of the assessment results for the modeling diagnostic task. This task was assessed using the modeling rubric designed by Garfunkel & Montgomery (2019) in GAIMME, which evaluates criteria across the seven stages of mathematical modeling. The results are as follows:

Table 1. Assessment Results of the Modeling Diagnostic Task

No	Aspect	Average
1	Describing/Understanding	94,44%
2	Specifing/Simplifyng	90,22%
3	Formulating/Mathematising	84,72%
4	Solving	77,78%
5	Interpreting	86,11%
6	Evaluating/Validating	79,17%
7	Reporting	86,11%
	Overall	**85.52%**

The assessment results of the diagnostic task indicate that the pre-service teachers' modeling competency was high, with an overall score of 85.52%. The Describe/Understanding stage obtained the highest score (94.44%), indicating that participants were highly capable of understanding the context and identifying relevant information. TheSpecify or Simplifying and Formulating or Mathematizing stages also showed good achievement (90.22% and 84.72%, respectively), suggesting that pre-service teachers were sufficiently competent in simplifying phenomena and constructing mathematical models. However, performance on the Interpreting and Evaluating/Validating stages was lower (86.11% and 79.17%, respectively), reflecting a tendency for pre-service teachers to be stronger in the mathematical aspects compared to the reflective and evaluative aspects of the model.

These findings are in line with various international studies that show similar patterns. Maass et al. (2019) and Schukajlow & Kaiser (2020a) reported that pre-service teachers typically excel in the formulation and solution stages but are weaker in interpretation and validation, especially when assessing the model's suitability with the real-world phenomenon. Ferrando and Font (2021) also found that pre-service teachers struggled to provide justifications for the model's assumptions or limitations due to a lack of authentic experience in modeling instruction. Thus, although these findings indicate that pre-service teachers' modeling abilities are quite good, strengthening the interpretation, validation, and reporting stages remains a critical need in the development of mathematics teacher education curricula.

3.2. Pre-service Teachers' Pedagogical Readiness in Mathematical Modeling Instruction

Figure 1. Pedagogical readiness for mathematical modeling among preservice teachers

In general, the research findings indicate that the pedagogical readiness of pre-service teachers in mathematical modeling instruction was high, with scores for all aspects ranging from 81–88%. These findings indicate that the pre-service teachers possess a strong foundation in understanding modeling concepts, instructional design, and the practical dynamics of facilitating the modeling process in the classroom. Specifically, the measured aspects reflect the key elements of pedagogical readiness identified in recent literature, such as understanding the modeling sequence, providing scaffolding, conducting process assessment, and analyzing student thinking (Kaiser & Brandenberg, 2022; Jacobs et al., 2010). The high overall score suggests that the intervention, consisting of the modeling task and the contextual lesson plan, successfully provided a meaningful learning experience for the pre-service teachers.

For the first three aspects, pre-service teachers demonstrated good initial familiarity with modeling (81.81%), positive perceptions of the lesson plan quality and learning sequence (83.78%), and a highly positive perception of the scaffolding within the task structure (85.56%). They understood that modeling differs from ordinary contextual problems and that the lesson plan sequence was progressively structured according to the modeling stages.

The high score for scaffolding (85.56%) indicates that pre-service teachers recognize how incremental support can guide students without compromising their learning autonomy, which is consistent with the findings of Park & Lee (2023) and Doerr & English (2022). This finding confirms that their understanding of modeling-based instructional design is well-developed, although their practical experience still needs to be strengthened.

In the next three aspects, the pre-service teachers' level of pedagogical readiness was even stronger. Pedagogical reflection and relevance received a high score (85.46%), indicating that participants were able to connect the modeling experience with didactic reasoning and noticing of student thinking. Experience with implementing

modeling tasks (86.79%) was also rated very positively, signifying that activities such as the Boom Crane task helped them understand how mathematical concepts can be authentically connected to real-world phenomena, as recommended by Doerr & English (2022).

The final aspect, the analysis of student readiness and potential conceptual difficulties, received the highest score (87.84%), indicating that the pre-service teachers possess strong diagnostic abilities. This aligns with the findings of Schukajlow & Kaiser (2020b), who emphasized the importance of a teacher's ability to identify the most difficult stages in modeling in order to provide appropriate pedagogical interventions. Overall, these three aspects (Aspects 4, 5, and 6) indicate that the pre-service teachers possess a solid foundation for implementing modeling instruction reflectively and responsively to student needs.

3.3. A Lesson Plan for a Scaffolded Modeling Task

The lesson plan in the Modeling Worksheet was designed as an alternative that pre-service teachers can use to implement modeling instruction in the classroom. In this study, the lesson plan was provided on the page before the modeling task narrative was given. This lesson plan included: modeling learning objectives, material prerequisites for students, required tools and materials, and the connection between the task's context and the national curriculum's learning outcomes.

The modeling task followed the seven-stage cycle (Describe–Report) with incremental scaffolding to systematically guide students in understanding the context, building the model, and evaluating outcomes. Each stage included targeted guiding questions—such as formulating assumptions, selecting coordinate systems, constructing equations, and interpreting results.

Scaffolding was provided in the form of simplified steps, information organization, and reflective guidance that enabled students to connect the real-world phenomenon with mathematical representations. This design is consistent with the GAIMME approach (Garfunkel & Montgomery, 2019) and is reinforced by recent research emphasizing the effectiveness of scaffolding in modeling instruction (Kaiser & Brandenberg, 2022; Park & Lee, 2023). Overall, this lesson plan presents a learning structure that is contextual, progressive, and capable of supporting both students and pre-service teachers in navigating the comprehensive modeling process.

4. CONCLUSION

This study indicates that the mathematical modeling competencies of pre-service teachers are high, particularly in understanding the context, simplifying the situation, and formulating the model. However, abilities in model interpretation and validation remain a weak point, indicating a gap between mathematical mastery and didactic understanding. On the other hand, the pedagogical readiness of pre-service teachers is

also at a high level, as evidenced by their ability to understand the modeling sequence, assess lesson plan quality, utilize scaffolding effectively, and identify potential student conceptual difficulties. These findings confirm that although pre-service teachers are strong in the cognitive aspects of modeling, strengthening the reflective, evaluative, and pedagogical aspects remains necessary to ensure that the classroom implementation of modeling instruction is optimal.

Based on these findings, this study suggests that teacher education programs broaden authentic learning experiences that allow pre-service teachers to practice modeling directly through microteaching, real-world context projects, and the analysis of modeling-based instruction practices. Faculty and curriculum developers are advised to strengthen instruction that emphasizes model validation and evaluation, as well as provide scaffolding tools that can serve as a reference for pre-service teachers in designing instruction. Furthermore, partner schools and field mentors can serve as a practical environment that supports the development of pedagogical noticing and modeling facilitation skills. Through this collaborative effort, the integration of mathematical modeling in teacher education can be realized more effectively and contribute to producing teachers who are competent, reflective, and prepared for the demands of 21st-century learning.

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Study of Technostress among Teachers: Its Relationship with Self-Efficacy in Implementation of Merdeka Curriculum

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ABSTRACT

This study aims to examine the relationship between technostress and self-efficacy among junior high school teachers in the implementation of the Merdeka Curriculum. Technostress refers to the psychological pressure that arises from the demands of technology use in the teaching and learning process, whereas self-efficacy refers to teachers' beliefs in their own abilities to manage digital learning tasks and challenges. This research employed a quantitative approach with a correlational design, involving 124 junior high school teachers in Paseh, Bandung Regency. The instruments used were the Technostress Scale, which includes five dimensions (learning–teaching process oriented, profession oriented, technical issue oriented, personal oriented, and social oriented), and the Self-Efficacy Scale based on Bandura's theory, consisting of three dimensions: magnitude, strength, and generality. Data were analyzed using Spearman's rank correlation test, which revealed a significant negative relationship between technostress and self-efficacy (Spearman's rho = –0.585, $p < 0.001$). These findings indicate that higher levels of self-efficacy are associated with lower levels of technostress among teachers. The results highlight the importance of strengthening teachers' self-efficacy to better manage technological challenges in implementation of the Merdeka Curriculum.

Keywords: *merdeka curriculum, teachers, technostress, self-efficacy*

1. INTRODUCTION

The implementation of the Merdeka Curriculum, which emphasizes flexibility and learner autonomy, has reinforced the role of technology as a central medium in classroom management, assessment, and reporting of learning outcomes. The integration of technology is expected to enhance instructional effectiveness and expand access to digital learning resources. However, the digital transformation within education has not been without challenges. While technological advancement provides numerous opportunities for innovation, it also introduces new forms of psychological strain among educators, a phenomenon commonly referred to as technostress (Tarafdar, 2014).

Technostress is defined as a type of stress that arises when individuals are unable to adapt to the demands of technology use. Within the educational context, this phenomenon has become increasingly prevalent among teachers, particularly during the implementation of the Merdeka Curriculum, which requires creativity, innovation, and technological competence. Such pressures may stem from difficulties in operating digital tools, adapting to online administrative systems, and the lack of adequate

technological infrastructure in schools (Coklar, 2017). Teachers who are less familiar with digital systems often experience anxiety, confusion, and emotional exhaustion due to the growing complexity of technology-driven work demands.

According to Coklar (2017), technostress among teachers comprises five interrelated dimensions: (1) Learning–Teaching Process Oriented, referring to stress caused by difficulties in utilizing technology for instructional purposes; (2) Profession Oriented, which pertains to pressure arising from increased workload and concerns over changes in professional identity; (3) Technical Issue Oriented, related to technological disruptions such as network failures or device malfunctions; (4) Personal Oriented, encompassing feelings of inadequacy or lack of confidence in mastering new technologies; and (5) Social Oriented, which emerges from diminished social interactions and potential miscommunication within digital environments. These dimensions indicate that technostress is not solely a consequence of technical challenges but also reflects psychological and social aspects inherent in technology-mediated teaching.

Although technology facilitates teaching and learning processes, it simultaneously imposes considerable psychological burdens on educators. Teachers are increasingly expected to manage virtual classrooms, employ interactive learning media, and conduct technology-based assessments. In the absence of sufficient training and institutional support, these demands may result in excessive workload, decreased job satisfaction, and reduced teaching efficacy (Zheng, 2024). This is supported by the findings of Meyla Eka Ningtyas and Agus Sugiarto (2022), who reported high levels of technostress among elementary school teachers in Kecamatan Tuntang, despite their extensive teaching experience. These results suggest that years of professional experience do not necessarily correspond with technological adaptability.

Teacher stress, burnout, and diminished self-efficacy caused by technology have been shown to negatively influence students' academic outcomes. Research indicates that teachers with low self-efficacy are associated with poorer academic performance (Herman, Prewett, et al., 2020) as well as increased behavioral problems among students (Herman et al., 2018). Furthermore, Herman et al. (2018) reported that students taught by teachers experiencing high levels of stress and burnout tend to demonstrate lower academic achievement and more disruptive behaviors. Supporting these findings, a systematic review by Madigan and Kim (2021) revealed that elevated teacher stress is frequently linked to reduced student motivation and lower academic achievement.

One of the most influential factors in mitigating technostress is self-efficacy, defined as an individual's belief in their capability to organize and execute actions required to manage prospective situations (Bandura, 1997). Teachers with high self-efficacy tend to be more confident in integrating technology into their pedagogy, better

prepared to address technical challenges, and more capable of developing adaptive strategies for digital instruction. Conversely, teachers with low self-efficacy are more vulnerable to anxiety and stress when confronted with technology-based teaching demands (Magistra, 2021).

Despite the growing body of research highlighting the negative relationship between self-efficacy and technostress, empirical evidence within the context of the Merdeka Curriculum in Indonesia remains limited. The Merdeka Curriculum requires teachers to be independent, reflective, and innovative in designing student-centered learning activities. This paradigm shift necessitates a high level of self-efficacy for teachers to effectively manage digital pressures while maintaining psychological well-being. Prior studies (Effiyanti & Sagala, 2018; Saringatun, 2021) have demonstrated that technostress can diminish teachers' performance and productivity, particularly when unaccompanied by adequate psychological and organizational support. Teachers who perceive themselves as less capable or unsupported by their institutions are more likely to experience emotional fatigue, frustration, and a decline in instructional quality. Therefore, enhancing teachers' self-efficacy represents a crucial strategy for mitigating the adverse effects of technostress, especially amidst the ongoing digital transformation within the educational landscape.

2. METHODOLOGY

2.1 Research Design

This study employed a quantitative approach with a correlational research design, aimed at analyzing the relationship between technostress and self-efficacy among junior high school teachers during the implementation of the Merdeka Curriculum. The quantitative approach was chosen because the data were numerical and analyzed statistically. The correlational design was used to determine the direction and strength of the relationship between the two variables.

2.2 Participants of the Study

The participants consisted of 124 junior high school teachers in Kecamatan Paseh, Bandung Regency, West Java, Indonesia. The sampling technique used was convenience sampling, a non-probability method in which participants were selected based on their availability and willingness to participate in the study. The inclusion criteria were as follows: 1) Active junior high school teachers; 2) Teachers involved in the implementation of the Merdeka Curriculum at their respective schools; 3) Teachers aged between 25 and 60 years old.

Paseh was selected due to its ongoing adoption of the Merdeka Curriculum and the varying levels of schools' readiness in applying digital learning and school management systems.

2.3 Instruments

Two instruments were used in this study are Technostress Scale and Self Efficacy Scale. Technostress scale adapted from the Teachers Technostress Levels Defining Scale developed by Coklar (2017), consisting of five dimensions: learning–teaching process oriented, profession oriented, technical issue oriented, personal oriented, and social oriented. The instrument utilized a five-point Likert scale (1 = strongly disagree to 5 = strongly agree).

Self-Efficacy Scale adapted from Bandura's (1997) self-efficacy theory and the New General Self-Efficacy Scale developed by Chen et al. (2001), comprising three dimensions: magnitude, strength, and generality, rated on a five-point Likert scale.

Both instruments underwent content validation (expert judgment) by educational psychology experts and reliability testing using Cronbach's Alpha, which indicated satisfactory internal consistency.

2.4 Data Collection Procedure

Data were collected through an online questionnaire (Google Form) distributed to junior high school teachers in Bandung Regency. Participation was voluntary, and respondents were assured of anonymity and confidentiality. Each questionnaire included an informed consent section to ensure that participants agreed to take part willingly and with full understanding.

2.5 Data Analysis Techniques

The collected data were analyzed using Spearman's Rank Correlation Test (Spearman's rho) to examine the relationship between technostress and self-efficacy. This non-parametric test was selected because the data were ordinal and not normally distributed. Statistical analyses were conducted using JASP software, with a significance level set at 0.05.

3. RESULT AND DISCUSSION

3.1 Normality Test

Table 1. Normality Test Results using Shapiro

	Shapiro-Wilk	p
TS - SE	0.982	0.328

The normality test was conducted using the Shapiro–Wilk Test to examine whether the data distribution met the assumption of normality. The test results showed that the data were normally distributed, with a Shapiro–Wilk value of 0.988 and a significance level (p = 0.328) greater than 0.05 (> 0.05). These results indicate that the

distribution of the technostress (TS) and self-efficacy (SE) variables met the assumption of normality.

Even though the data fulfilled the normality assumption, the analysis in this study employed the Spearman rank correlation test. This non-parametric test was chosen because both technostress and self-efficacy variables were measured using Likert-scale instruments, which are ordinal in nature. The Spearman correlation analysis aimed to determine the strength and direction of the relationship between technostress and self-efficacy among teachers in the implementation of the Merdeka Curriculum. The results are expected to provide empirical insight into how teachers' self-efficacy influences their ability to manage technostress in adapting to digital learning environments.

3.2 Correlation between technostress and self-efficacy

Table 2. Correlation Test Results

Variable		TS	SE
1. TS	Spearman's rho	-	
	p-value	-	
2. SE	Spearman's rho	-0.585	-
	p-value	< .001	-

Based on Table 2, the results indicate a significant relationship between technostress (TS) and self-efficacy (SE) among junior high school teachers. The Spearman correlation test showed a Spearman's rho value of –0.585 with $p < 0.001$. Since the p-value is smaller than 0.05, it can be concluded that there is a statistically significant relationship between technostress and self-efficacy. The negative Spearman's rho value indicates that the relationship between the two variables is negative and significant, meaning that higher levels of self-efficacy are associated with lower levels of technostress experienced by teachers. In other words, teachers who possess stronger confidence in their abilities tend to experience less psychological strain when dealing with technological demands in the implementation of the Merdeka Curriculum. This result aligns with the theoretical framework proposed by Bandura (1997), which states that individuals with strong self-efficacy beliefs are more capable of managing challenges, including those related to technological adaptation. Teachers who believe in their ability to handle digital tools and pedagogical technology are therefore less vulnerable to psychological strain arising from technological demands.

The negative association between both variables is consistent with previous empirical findings. Ostadrahimi (2024) reported that higher self-efficacy significantly reduces technostress among teachers engaged in technology-supported learning environments. Similarly, Zheng (2024) found that teachers with strong confidence in their technological competence are better able to cope with digital workload and exhibit

lower stress levels during the integration of e-learning systems. The current study strengthens these findings by demonstrating that the same pattern also applies within the context of the Merdeka Curriculum.

Table 3. Correlation test results between Technostress dimensions and self efficacy

	Spearman's rho	p
LT - SE	-0.492	< .001
PR - SE	-0.391	< .001
TI - SE	-0.520	< .001
PE - SE	-0.508	< .001
SO - SE	-0.509	< .001

Learning–Teaching Process Oriented (LT) demonstrated a negative correlation of –0.492 with Self-efficacy (SE), significant at $p < .001$. This indicates that higher levels of self-efficacy are associated with lower levels of stress related to integrating technology into the teaching–learning process. The LT dimension reflects pressures such as developing digital instructional materials, managing online classrooms, and using technology-based assessment platforms, tasks emphasized in the implementation of the Merdeka Curriculum. Teachers with high self-efficacy are more likely to interpret these demands as manageable challenges rather than threats. Prior research confirms that computer and digital self-efficacy negatively relate to technostress creators, indicating that teachers who feel more competent with technology report lower stress when designing technology-assisted instruction (Dong et al., 2020). The current findings reinforce this evidence by showing that confidence in technological competence reduces pedagogical tensions related to technology integration.

Profession Oriented (PR) showed a significant negative correlation of –0.391 with Self-efficacy (SE), suggesting that although self-efficacy contributes to reducing professional stress, the magnitude is smaller than in other dimensions. The PR dimension concerns fears about shifting professional roles, increasing digital workloads, and concerns about job security as technology reshapes educational practices. Teachers with higher self-efficacy are better prepared to manage these evolving expectations, including digital communication, online administrative tasks, and the integration of new digital policies. Previous research demonstrated that technostress increases burnout and decreases job satisfaction and work performance, particularly when digital responsibilities rise without adequate institutional support (Tu et al., 2025). Thus, teachers who believe in their ability to navigate technological changes tend to experience less profession-related technostress.

Technical Issue Oriented (TI) had the strongest negative correlation with Self-efficacy (SE) at –0.520, significant at $p < .001$, indicating that self-efficacy is highly

influential in reducing stress arising from technical problems. The TI dimension encompasses difficulties such as unstable internet connections, device malfunctions, software errors, account management issues, and data security concerns. Teachers with strong technological self-efficacy tend to remain calm and solution-focused when facing such disruptions. This is consistent with evidence showing that self-efficacy in digital competence negatively predicts technostress creators among secondary school teachers (Zivi et al., 2025). Additionally, cross-cultural findings show that technology self-efficacy is negatively associated with technostress, while excessive technology use can increase stress (Cazan et al., 2024). These findings support the conclusion that teachers' confidence in handling technical issues substantially mitigates technostress in this domain.

Personal Oriented (PE) demonstrated a negative correlation of –0.508 with Self-efficacy (SE) and was significant at $p < .001$. This dimension reflects personal feelings related to technology, such as perceiving oneself as incapable, fearing technological inadequacy, or depending heavily on more technologically skilled colleagues. The strength of the correlation suggests that personal perceptions and self-beliefs are closely intertwined with technostress. Research confirms that teachers with low computer self-efficacy are more vulnerable to techno-anxiety and more reluctant to explore new technologies (Zhong, 2025). Additional evidence shows that teachers' educational technology self-efficacy negatively predicts technostress levels, indicating that teachers who perceive themselves as competent in meeting educational technology standards tend to experience lower stress (Nartgün et al., 2024). This supports the conclusion that increasing self-efficacy not only reduces technical stress but also reshapes teachers' personal appraisal of technological challenges.

Social Oriented (SO) showed a negative correlation of –0.509 with Self-efficacy (SE), significant at $p < .001$. This dimension concerns stress related to changes in social interaction, including communication conflicts mediated by technology, reduced interpersonal connection, and blurred boundaries between work and personal life due to constant digital engagement. Teachers with high self-efficacy tend to manage communication more effectively, regulate their use of digital tools, and maintain social connectedness despite technological demands. Research among primary school teachers in China found that technostress contributes to work–family conflict and health issues, especially during technology-intensive periods such as distance learning (Wang et al., 2023). Cross-cultural evidence also indicates that technology self-efficacy and collegial social support are negatively associated with technostress, confirming their protective role against social strains created by technology use (Cazan et al., 2024). These findings align with the current study, indicating that teachers who feel competent technologically are better able to maintain positive social functioning and reduce social-oriented stress.

Overall, the consistent negative correlations across all technostress dimensions indicate that self-efficacy serves as a significant psychological resource for mitigating technology-related stress. Prior research has shown that technostress dimensions such as LT, PR, TI, PE, and SO are negatively associated with positive psychological resources, including psychological capital (Efilti & Çoklar, 2019). The present findings extend this understanding by demonstrating that self-efficacy specifically, defined as teachers' confidence in their own abilities, plays a crucial role in reducing technostress within the context of the Merdeka Curriculum. In general, this pattern indicates that the higher the teachers' self-efficacy, the lower the technostress they experience across all dimensions, a finding consistent with studies showing that technology-related self-efficacy functions as a protective factor against technostress among educators (Zivi et al., 2025).

These results suggest that professional development initiatives should not only focus on technical skills but also strengthen digital self-efficacy through mastery experiences, guided practice, peer collaboration, and constructive feedback. Such approaches have the potential to reduce technostress across instructional, professional, technical, personal, and social domains, enabling teachers to adapt more effectively to the digital demands of the Merdeka Curriculum.

4. CONCLUSION

This study examined the relationship between technostress and self-efficacy among junior high school teachers in the implementation of the Merdeka Curriculum. The findings revealed significant negative correlations between self-efficacy and all five dimensions of technostress such as learning–teaching process oriented, profession oriented, technical issue oriented, personal oriented, and social oriented. These results indicate that teachers with higher levels of self-efficacy tend to experience lower levels of technostress when integrating digital tools and platforms into their instructional and administrative tasks. The study provides empirical support for the role of self-efficacy as a psychological resource that helps teachers manage technological demands more effectively. The findings underscore the need for targeted professional development programs that strengthen teachers' digital competence and confidence. Enhancing self-efficacy through mastery experiences, mentoring, collaborative learning, and supportive school environments may reduce technostress and improve teachers' readiness to implement the Merdeka Curriculum. Future research may expand this work by examining additional moderating variables, exploring longitudinal patterns, or comparing technostress levels across different school contexts to deepen understanding of teachers' digital adaptation in educational reform.

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Teacher Strategies for Creating Meaningful and Joyful Learning in Elementary Schools

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ABSTRACT

This study aims to describe teachers' strategies in realizing meaningful and joyful learning in elementary schools. Using a qualitative approach with a case study design, this study involved two elementary school teachers in Bandung Regency. Data were collected through observation, interviews, and documentation, then analyzed using Miles and Huberman's interactive model, which includes data reduction, data presentation, and conclusion drawing. The results showed that teachers designed learning by relating the material to students' real experiences, using a contextual approach, and utilizing technology-based media such as videos, games, and digital tools. The learning process was made enjoyable through singing, playing, and interactive discussions that encouraged active student participation. Despite obstacles such as time constraints and differences in student motivation, teachers were able to overcome them through creative lesson planning and efficient classroom management. The application of these strategies has been proven to increase students' enthusiasm, engagement, and understanding of the learning material. Overall, meaningful and enjoyable learning contributes significantly to improving the quality of learning and creating a positive learning experience in the classroom.

Keywords: *elementary school, joyful learning, meaningful learning, qualitative research, teacher strategies*

1. INTRODUCTION

Basic education is an important foundation in shaping students' character, knowledge, and skills. At this level, the learning process is not only aimed at transferring knowledge, but also at fostering interest in learning, curiosity, and active student involvement in the learning process (Purwanti et al., 2023). However, in reality, many teachers still apply conventional learning methods, namely teacher-centered learning with monotonous lectures and assignments. This condition causes students to quickly become bored, passive, and less understanding of the meaning of the material being studied (Cahyani, 2020).

To overcome these problems, teachers need to create meaningful and Joyful Learning experiences. Meaningful learning occurs when students are able to relate new knowledge to their previous experiences or knowledge (Ramadhani et al., 2024). According to Ausubel's theory of meaningful learning, the learning process will be more effective if students understand the relationship between new concepts and existing cognitive structures (Nefi, 2023). Meanwhile, Joyful Learning creates a positive,

interactive classroom atmosphere that encourages students to participate actively without pressure. The combination of these two approaches is believed to increase learning motivation, creativity, and learning outcomes of students in elementary school (Ningrum & Panjali, 2024).

Teachers play a central role in realizing both types of learning. Through appropriate learning strategies such as the use of interactive media, contextual approaches, educational games, or collaborative activities, teachers can transform the learning atmosphere into a more lively and meaningful one for students (Nurhayati & , Langlang Handayani, 2020). However, in practice, not all teachers are able to design strategies that are appropriate to the characteristics of students and learning objectives (Chung, 2020). Therefore, it is important to examine how teachers implement meaningful and Joyful Learning strategies in elementary schools as an effort to improve the quality of learning.

2. METHODOLOGY

This study uses a qualitative approach with a case study design, as it aims to describe in depth the strategies used by teachers in realizing meaningful and Joyful Learning in elementary schools (Waruwu, 2023).

2.1. Research Design

This study uses a descriptive qualitative research design. This design was chosen because the main objective of the study is to describe in depth the phenomenon of teacher strategies in creating meaningful and Joyful Learning based on real situations in the field (Santi, 2024).

2.2. Participants of the Study

The participants in this study consisted of two elementary school teachers, each teaching fourth and fifth grade at a public elementary school in Bandung (or a location deemed relevant by the researcher).

2.3. Instruments

The instruments used in this study consisted of observation guidelines, interview guidelines, and documentation. The observation guidelines were used to observe how teachers implemented meaningful and Joyful Learning in the classroom, including teaching strategies, use of media, and student participation (Sahara et al., 2025). The interview guidelines were designed to be semi-structured and aimed to explore teachers' strategies, obstacles, and reflections in creating meaningful and Joyful Learning, focusing on seven aspects, namely lesson planning, meaningful learning, Joyful Learning, use of learning media, obstacles encountered, impact on students, and teacher reflections. Meanwhile, documentation is used to collect supporting data such

as Lesson Plans (RPP), learning media, and photos of learning activities in the classroom. All instruments are validated through expert judgment to ensure the relevance and clarity of the questions.

2.4. Data Analysis Techniques

The data in this study were analyzed using Miles and Huberman's (1994) interactive model, which consists of three main stages, namely data reduction, data presentation, and conclusion drawing or verification (Futri et al., 2024). In the data reduction stage, information obtained from observations, interviews, and documentation was selected and simplified to focus on teachers' strategies in implementing meaningful and Joyful Learning. The data was then presented in descriptive form to identify patterns and relationships between findings, followed by drawing conclusions through repeated interpretation and verification to ensure data accuracy and consistency. To maintain data validity, this study applied source triangulation and technique triangulation by comparing information obtained from teachers and different data collection methods (Luthfiyani & Murhayati, 2024).

3. RESULT AND DISCUSSION

The results of the study show that teachers design meaningful and Joyful Learning through material analysis, discussions with colleagues, and the use of technology such as TikTok, AI, and various learning media (Sartimah, 2025). In preparing lesson plans, teachers adjust the level of difficulty of tasks based on student characteristics so that all students are facilitated without anyone being left behind (Rosmana et al., 2024). Learning is carried out by linking the material to the students' real experiences and providing opportunities for exploration through independent experiments, which elicit enthusiastic responses even though some students give up easily when they encounter difficulties (Levy & Mensah, 2021). Learning is made enjoyable through games, gadgets, songs, and ice breakers, while media such as projectors, computers, and touch screens have been proven to increase students' interest and understanding (Wana et al., 2024). The obstacles that arise include varying student motivation, time constraints, and dense material, but teachers overcome these with efficient activities. Overall, the strategies implemented had a positive impact on student activity, motivation, and learning attitudes, and teachers plan to continue developing them (Nur Aziza Basuki et al., 2024).

The findings of this study were generated from a systematic review of observational data from the learning process, teacher reflections, and documentation of learning tools, which were then selected and grouped into key themes of pedagogical practice. The analysis revealed that developing meaningful learning does not occur instantly, but rather through reflective stages involving review of teaching materials,

professional collaboration with colleagues, and the selection of contextual learning media appropriate to student characteristics. Adjusting the complexity of assignments in lesson plans reflects teachers' pedagogical awareness of the diversity of student abilities, which is analytically evident through the application of a gradual and adaptive assignment strategy.

Furthermore, linking learning materials to authentic student experiences and providing opportunities for exploration through independent experimentation reflect the application of experiential learning, as indicated by increased student participation and enthusiasm during learning activities. Variations in student responses, including some students' tendency to give up quickly, were identified as indicators of challenges in self-regulation skills in active learning. The use of digital technology, including audiovisual media and commonly used platforms, has been empirically proven to increase student attention and understanding, as reflected in the level of student engagement in classroom learning activities. Time constraints and dense material content were examined as structural factors in learning, which teachers then anticipated through the implementation of efficiency strategies and prioritizing activities. In general, the research results showed a positive relationship between the implementation of adaptive learning strategies and increased student motivation, activeness, and learning attitudes.

Theoretically, the results of this study reinforce the constructivist perspective, which emphasizes that knowledge is actively constructed through learning experiences and interactions with the environment (Piaget; Vygotsky). Teachers' efforts to connect learning materials to students' real-life contexts reflect the application of meaningful learning according to Ausubel, making learning more relevant and meaningful because it aligns with students' cognitive structures. The establishment of varying levels of task difficulty represents the application of differentiated instruction (Tomlinson), which is not merely a technical strategy but also an inclusive approach to ensuring equitable learning for all students.

The use of digital technology and creative media can be interpreted as the application of technology-enhanced learning that functions as cognitive tools, not merely as entertainment. The finding that some students tend to give up quickly suggests the importance of strengthening self-regulated learning and a growth mindset, common challenges in activity-based learning. Time constraints and material density highlight the pedagogical dilemma between curriculum demands and the need for deep learning. However, teachers' ability to flexibly adapt learning strategies reflects adaptive competencies aligned with the concept of reflective teaching. Thus, the findings of this study not only describe effective learning practices but also provide empirical evidence that meaningful learning requires a balance between pedagogical design, technology utilization, and sensitivity to student needs.

4. CONCLUSION AND RECOMMENDATIONS

This study concludes that the learning strategies implemented by teachers are able to create meaningful and Joyful Learning experiences for students. Teachers design lessons by considering the characteristics and ability levels of students, as well as utilising various sources and technological media to create varied learning activities. Implementing lessons that relate the material to real-life experiences and provide room for exploration has been proven to increase student motivation, activity, and understanding of the material. The use of games, gadgets, and creative activities also helped to create a positive and interactive classroom atmosphere. Although there were obstacles such as time constraints and differences in student motivation, teachers were able to overcome them by adjusting their strategies and streamlining activities. Overall, the strategies used were effective in improving the quality of the learning process and outcomes, and are worth continuing to develop as part of classroom learning innovation.

This research contributes theoretically by strengthening the understanding of meaningful learning through the integration of adaptive pedagogical design, technology utilization, and attention to learner characteristics. Practically, these findings provide a reference for teachers in designing contextual, flexible learning strategies that encourage active student engagement. Policy implications point to the need for systematic support for the development of teachers' pedagogical competence and technological literacy. Future research is recommended to involve more diverse contexts and educational levels, use a more robust methodological approach, and examine factors supporting the sustainability of meaningful learning implementation.

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Teaching English in A Digital World: Mindful, Meaningful, and Joyful Learning

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ABSTRACT

The rapid advancement of digital technology has significantly reshaped English Language Teaching (ELT), presenting both pedagogical opportunities and challenges related to learner engagement, attention, and well-being. While digital tools enhance access and interactivity, demanding educators to innovate pedagogical approaches. They also risk cognitive overload and emotional disengagement if not pedagogically grounded. This study aims to examine how mindfulness-informed digital pedagogy can support meaningful, joyful, and holistic learning in ELT. This paper employs a systematic literature review drawing on peer-reviewed 2018-2025 in the fields of digital pedagogy, mindfulness in education, and English language teaching (ELT). The review focuses on three thematic areas: (1) the role of mindfulness in sustaining attention and emotional regulation in digital environments; (2) instructional strategies that promote meaningful learning and reduce cognitive overload; and (3) digital tool and classroom designs that cultivate joy, motivation, and supports holistic student development in the digital era. The findings offer insights for educators, curriculum designers, and policymakers to reimagine English language education as a transformative process for naturing well-being, engagement, and lifelong learning.

Keywords: *digital learning, English language teaching, joyful, meaningful, mindful.*

1. INTRODUCTION

The rapid advancement of digital technologies has reshaped virtually every aspect of human life, including educational systems and language learning environments. The transformation of learning environments and reshaped the pedagogical landscape of English Language Teaching (ELT) has undergone a major transformation as digital platforms increasingly mediate communication, interaction, and instruction. Digital platforms such as Learning Management Systems (LMS), AI powered applications, video-based learning tools, and virtual collaborative spaces offer increased accessibility and flexibility (Hockly, 2018). Nevertheless, the shift to digital learning also introduces challenges such as digital fatigue, increased cognitive load, shortened attention span, and reduces emotional connection among learners (Pegrum, 2020).

A shift from traditional classroom-based learning hybrid and fully online formats has opened opportunities for flexible, personalized, and accessible learning. At the same time, digital learning introduces challenges such as fatigue, multitasking, cognitive overload, reduced social presence, and declining learner motivation (Rahimi

and Fathi, 2021). Digital platforms, artificial intelligence (AI), mobile assisted language learning (MALL), and multimodal learning environments have redefined how learners access, interact with, and internalize linguistic content. These transformations create opportunities for more flexible, interactive, and engaging instruction, yet they simultaneously present new challenges related to cognitive overload, digital distraction, superficial engagement, and emotional fatigue. In response to these emerging issues, current pedagogical discussions emphasize the need to integrate human centered approaches that not only leverage digital innovation but also foster well-being, deeper learning, and positive learning experiences. Within this context, the concepts of mindful, meaningful, and joyful learning become increasing important for sustaining high-quality English language education in a digital world.

From a theoretical perspective, the integration of mindfulness in education draws from the work of scholars such as Kabat-Zinn (2003), Jennings (2015), and Shapiro et al. (2020), who argue that mindfulness improves attention regulation, emotional balance, and cognitive clarity. In digital environments that are highly saturated with distractions, mindfulness can serve as a pedagogical anchor that allows learners to stay present and engaged during online English learning activities. Meaningful learning, based on Jonassen's (2000) constructivist theory, emphasizes active knowledge construction, conceptual integration, and personal relevance. This concept aligns well with digital pedagogical approaches that encourage authentic communication tasks, problem-based activities, and multimodal meaning-making processes. Meanwhile, joyful learning is grounded in positive psychology, particularly the broaden-and-build theory (Fredrickson, 2001), which highlights how positive emotions enhance motivation, creativity, and resilience. In digital English language teaching (ELT), joyful learning can emerge from gamification, collaborative digital storytelling, interactive multimedia, and community-building platforms that promote social presence.

Although each of these three constructs mindfulness, meaningfulness, and joy has been widely explored in the field of education, there remains a lack of integrated studies that examine how they collectively support digital ELT environments. Furthermore, existing technological integration frameworks such as TPACK (Mishra & Koehler, 2006) and SAMR (Puentedura, 2013) primarily focus on pedagogical-technical alignment, but do not explicitly address learners' emotional and cognitive well-being. As a result, there is a theoretical gap regarding how digital English teaching can be designed to promote not only linguistic competence but also human-centered learning experiences that nurture focus, relevance, and enjoyment. Addressing this gap is essential to ensure that English learning in the digital era remains sustainable, learner-oriented, and psychologically supportive.

To contextualize the development of digital ELT research, Table 1 presents a selection of representative publications from 2018 to 2025. These studies highlight

major themes such as digital literacy, multimodal learning, AI-based instruction, hybrid classrooms, and learner engagement strategies. The growing diversity of research focus areas illustrates the dynamic evolution of the field and reinforces the urgency of examining pedagogical principles that align with current technological trends. The design of targeted professional development programs and underscore the need for policy frameworks that recognize the teacher as a central agent of peace-building in educational settings (Gifari et al., 2025).

Against this backdrop, scholar argue for more holistic pedagogical approach that humanizes digital learning through the integration of mindfulness, meaningful learning, and joyful learning (Mercer and Gregersen, 2020). These three components support learners' emotional well-being, enhance cognitive engagement, and foster intrinsic motivation factors crucial for effective learning in digital ELT contexts. Mindfulness helps learners sustain attention, regulate screen-induced stress, and remain emotionally grounded (Shapiro, 2020). Meaningful learning ensures learners connect new content to prior knowledge and real-world contexts (Jonassen, 2000). Joyful learning contributes to positive emotions that broaden cognitive and creative capacities (Fredrickson, 2001). However, although each concept has been explored individually, fewer studies integrate these three constructs within ELT settings. Digital transformation in education is like a double-edged sword. On the one hand, technology brings opportunities to radically improve education systems. On the other hand, challenges related to access gaps, technological literacy, and ethics need to be addressed to maximize the benefits of this technology (Najmudin et al., 2025)

The review focuses on three thematic areas: (1) the role of mindfulness in sustaining attention and emotional regulation in digital environments; (2) instructional strategies that promote meaningful learning and reduce cognitive overload; and (3) digital tool and classroom designs that cultivate joy, motivation, and supports holistic student development in the digital era. By achieving these objectives, the study is expected to contribute valuable insights into human centered digital pedagogy and support the professional development of English teachers globally. It provides a theoretical foundation and practical guidance for designing digital English learning that is not only technologically enriched but also mindful, meaningful, and joyful. In the long run, the development of such pedagogical approaches has the potential to foster sustainable learner engagement, enhance learning outcomes, and promote emotional well-being in increasingly digitalized educational environments.

To address these challenges, educators increasingly integrate mindfulness, meaningful learning, and joyful learning into ELT. Mindfulness enhances learners' emotional regulation and focus, meaningful learning fosters deep understanding, and joyful learning supports intrinsic motivation and positive engagement. Although their importance, research integrating these three components within ELT in digital settings

remains limited. The important of teaching English in a digital world through mindful, meaningful, and joyful learning is the transformative process for naturing well-being, engagement, and lifelong learning.

2. METHODOLOGY

The roadmap that guides the plan researchers in collecting, analyzing, and interpreting the information to answer the research reliably. The methodology includes detailed procedures for data collection, sampling techniques, data resources, characteristics of the reviewed studies, instruments used for analysis, and the analytical techniques applied. The SLR approach allows for a comprehensive, replicable, and transparent process of identifying, evaluating, and synthesizing research findings published between 2018 and 2025.

This study adopts a post-positivist research paradigm situated within a socio-educational perspective, recognizing that pedagogical knowledge is socially constructed yet can be systematically examined through rigorous and transparent procedures. Rather than seeking causal generalizations, the study aims to generate analytical generalizations by identifying recurring patterns, concepts, and pedagogical principles across empirical and conceptual literature. This epistemological stance is particularly appropriate for exploring mindfulness-informed digital pedagogy in English Language Teaching (ELT), a field characterized by contextual variability, learner diversity, and evolving technological practices. Accordingly, the study employs a Systematic Literature Review (SLR) guided by the SALSA framework (Search, Appraisal, Synthesis, and Analysis), which is widely used in education and social science research for theory-driven and thematic inquiry.

Search Strategy is a comprehensive and systematic search was conducted to identify peer-reviewed studies published between 2018 and 2025, reflecting recent developments in digital pedagogy and mindfulness-informed education. The search covered major academic databases commonly recognized by Scopus and Web of Science (WoS)-indexed journals, including scopus, Web of Science Core Collection, ERIC, and Goosle Scholar (for supplementary screening).

Appraisal (inclusion and exclusion criteria) is the Following the initial identification, studies were appraised using explicit inclusion and exclusion criteria to ensure relevance and methodological rigor. Inclusion criteria consist of peer-reviewed journal articles, published between 2018 and 2025, focus on ELT/EFL/ESL contexts, address mindfulness, learner well-being, meaningful learning, or joyful digital pedagogy, and employ qualitative, quantitative, mixed-methods, or conceptual approaches. Moreover, the exclusion criteria consist of conference proceedings, book reviews, editorials, and dissertations, studies unrelated to language education, articles lacking pedagogical or educational implications, and purely technical studies without

learning or teaching dimensions. Quality appraisal emphasized conceptual clarity, methodological transparency, and relevance to educational practice, consistent with Scopus/WoS expectations.

Synthesis is selected studies were subjected to thematic synthesis. Data extraction focused on research context and educational setting, theoretical frameworks (e.g., mindfulness, cognitive load theory, meaningful learning), pedagogical strategies and instructional designs, and reported outcomes related to engagement, emotion regulation, and learner well-being. Through iterative coding and comparison, recurring concepts and patterns were clustered into three overarching thematic categories, those are mindfulness and attention/emotional regulation in digital ELT environments, instructional strategies fostering meaningful learning and reducing cognitive overload, and digital tools and learning designs promoting joy, motivation, and holistic development.

Analysis is the final analytical stage involved interpretive and comparative analysis, aligning synthesized themes with broader socio-educational and post-positivist perspectives. Rather than aggregating effect sizes, the analysis sought to explain *how* and *why* mindfulness-informed digital practices function in ELT, identify pedagogical affordances and constraints across contexts, generate integrative insights for curriculum design, teacher education, and policy

This analytical approach strengthens the study's theoretical contribution while maintaining methodological transparency.

2.1. Research Design

The study adopted a qualitative research approach using a systematic literature review design. This design is appropriate for identifying patterns, themes, and conceptual relationships across a body of published literature and for generating a theoretically grounded synthesis of pedagogical frameworks relevant to digital ELT. The systematic review followed four major stages: (1) identification of relevant studies, (2) screening and eligibility filtering, (3) quality appraisal and data extraction, and (4) thematic synthesis.

The identification stage involved structured searches across several academic databases, including Scopus, Web of Science (WoS), ERIC, and Google Scholar. The keywords used combined three conceptual clusters: (a) mindfulness (e.g., "mindfulness in education", "attentional regulation"), (b) meaningful learning (e.g., "constructivist digital learning", "deep learning in ELT"), and (c) joyful learning (e.g., "positive emotions", "gamification", "digital engagement"). The screening stage involved removing duplicates and excluding non-academic sources such as websites, editorials, and essays. Articles that did not focus on digital contexts or English language teaching

were also excluded. Only peer-reviewed journal articles, conference papers, and book chapters published in English between 2018 and 2025 were considered.

This study adopted a systematic literature review (SLR) approach. Following guidelines by Kitchenham (2004), the review involved structured procedures of identifying, selecting, and synthesizing relevant academic publications on digital pedagogy through ELT, mindfulness, meaningful learning, and joyful learning. The SLR design was chosen because the research aims not to test hypotheses but to consolidate and interpret existing scholarship, identify research gaps, and generate pedagogical recommendation.

2.2. Participants of the Study

In an SLR, the participants are the sources of data academic publications themselves. Because this research is a literature review, the participants are the selected academic sources, not individuals. This review analyzed 65 peer-reviewed journal articles, 12 book chapters, 7 conference proceedings, and 4 systematic reviews Those are published between 2018-2025. The primary focus on recent digital pedagogy scholarship and several foundational works (e.g., Jonassen, 2000; Fredrickson, 2001). Those are including empirical studies in digital ELT, theoretical papers on mindfulness and learning psychology, book chapters on positive education, and systematic reviews on technology-enhanced learning.

2.3. Instruments

The key instrument was a Literature Review Matrix, which coded each study based on authors and year, research focus and themes, methodology used, and pedagogical implications for ELT.

The extraction matrix was created in a spreadsheet and was piloted using five randomly selected articles to ensure clarity, reliability, and consistency. The pilot test verified that all categories could be applied uniformly across studies; adjustments were made to include two additional columns: “theoretical basis” and “technology type” to enrich the depth of analysis.

2.4. Data Analysis Techniques

Describe how the data was analyzed in the study. Describe how the data was analyzed in the study. Describe how the data was analyzed in the study.

Data were analyzed using thematic analysis. Those were including the initial coding of concepts related to mindfulness, meaningful learning, joyful learning, and digital pedagogy. Then, organization into thematic categories, cross-theme synthesis to identify connections across studies, and derivation of pedagogical principles relevant to ELT practitioners.

The data analysis process involved several stages, beginning with data organization through the extraction matrix, followed by coding, theme generation, and interpretative synthesis. Thematic analysis was employed as the primary analytical technique because it allows the identification of recurring patterns and relationships across diverse studies.

3. RESULT AND DISCUSSION

3.1. Results

The article conducts a systematic literature review (SLR) to synthesize pedagogical strategies and frameworks that support mindful, meaningful, and joyful English learning in digital era. Moreover, it is the key publications between 2018-2025 to synthesize best practice for cultivating mindful, meaningful, and joyful learning in digital English classrooms. The goal is not only to provide theoretical insight but also to purpose practical strategies aligned with technology enhanced pedagogy. It is in support of the English language education as a transformative process for naturing well-being, engagement, and lifelong learning.

The background and theoretical foundations above lead to several key problems addressed in this study. First, there is limited understanding of how mindfulness can be operationalized in digital English learning activities to reduce cognitive overload and enhance attention. Second, there is a need to identify effective strategies for fostering meaningful learning in technology enhanced ELT settings, especially when learners interact through multimodal texts and digital platforms. Third, despite the increasing availability of engaging digital tools, it remains unclear how joyful learning can be systematically incorporated into English instruction without compromising academic rigor. Finally, there is insufficient theoretical integration that connects these three dimensions mindful, meaningful, and joyful learning into a holistic pedagogical model suitable for the digital era.

To solve these problems, the present study proposes a systematic literature review that synthesizes empirical and conceptual research to examine the integration of mindfulness, meaningful learning, and joyful learning in digital English teaching. The review draws on publications indexed in Scopus, Web of Science, ERIC, and Google Scholar from 2018 to 2025. Through a structured selection and evaluation process, thematic analysis will be used to identify recurring patterns, pedagogical strategies, theoretical implications, and potential frameworks for implementation.

The Human centered digital ELT model illustrated in Figure 1 emphasizes the integration of three essential learning dimensions Mindfulness, Joyful Learning, and Meaningful Learning as the foundation for effective English language teaching in digital environments. Each dimension represents a core human need in learning, and their interplay creates a holistic approach that acknowledges learners' emotional, cognitive,

and motivational states. Rather than viewing digital learning merely as a technological process, this model positions the learner at the center, ensuring that pedagogical design supports well-being, engagement, and long-term development.

The first dimension, Mindfulness, focuses on cultivating learners' awareness, attention, and emotional balance during learning activities. In digital spaces where distractions are abundant, the ability to maintain concentration and regulate emotions becomes a critical factor for academic success. Mindfulness contributes to a stable psychological environment in which learners can process information more effectively, respond calmly to challenges, and sustain their focus throughout various tasks.

The second dimension, Joyful Learning, highlights the importance of positive emotions and intrinsic motivation in shaping learners' experiences. Joyful Learning acknowledges that students perform better when they feel enthusiastic, curious, and emotionally invested in the learning process. Through interactive digital tools, gamified activities, and supportive learning communities, this dimension strengthens learners' motivation and fosters an enjoyable atmosphere that enhances participation and persistence.

The third dimension, Meaningful Learning, ensures that classroom activities and digital materials are relevant, authentic, and deeply connected to learners' real-life experiences and goals. Meaningful Learning encourages deeper engagement by promoting critical thinking, contextual understanding, and purposeful use of language. When learners perceive tasks as useful and connected to their personal or professional lives, they are more likely to develop long-lasting competencies and engage in higher-order thinking.

At the intersection of these three dimensions lies Lifelong Learning, the ultimate goal of the model. Lifelong Learning emerges when students experience learning as enjoyable, relevant, and emotionally balanced. It reflects the development of learners who not only acquire language skills but also cultivate curiosity, resilience, and a sustained desire to learn beyond the classroom. By combining mindfulness, joy, and meaningful engagement, the Human-Centered Digital ELT Model provides a comprehensive framework that supports both academic achievement and the continuous growth of learners throughout their lives.

Furthermore, the result demonstrates a dynamic relationship. Mindfulness reduces stress is enabling mental space for meaningful learning. Meaningful tasks increase cognitive involvement is fostering intrinsic motivation. Joyful engagement enhances emotional well-being strengthening persistence and deeper learning. Thus, the integration of mindfulness, meaning, joy forms a holistic pedagogical approach that humanizes digital ELT environments.

Figure 1. Human-centered Digital ELT Model

Each study highlights an important aspect of digital English language teaching (ELT) and shows the progression of research trends from 2018 to 2025. Hockly (2018) outlines major digital developments in ELT and predicts future directions, setting the stage for understanding technological shifts. Pegrum (2019) expands this perspective by examining mobile learning and digital innovation. Zhao and Yan (2020) focus on online learner engagement, an essential factor in virtual learning environments. Rahimi and Fathi (2021) introduce digital storytelling as a tool to enhance EFL learners' skills, while Chien (2022) explores how artificial intelligence can support language learning. Adnan (2023) highlights the growing role of hybrid learning and its influence on student motivation. Wan and Chen (2024) emphasize gamification as a strategy to promote joyful learning in EFL contexts. Finally, Dudun Najamudin, Susanti, and Pebrian (2025) examine broader digital transformation in education, providing an updated understanding of systemic shifts.

Tabel 1. Key Studies in the Literature Review

No	Author	Year	Focus of Study
1.	Hockly	2018	Current and Future Digital Trends in ELT
2.	Pegrum	2019	Mobile learning and digital innovation
3.	Zhao and Yan	2020	Online learner enagagement
4.	Rahimi and Fathi	2021	Digital storytelling for EFL learners
5.	Chien	2022	AI-Supported language learning
6.	Adnan	2023	Hybrid learning and student motivation
7.	Wan and Chen	2024	Gamification and joyful EFL learning
8.	Dudun Najamudin, Lia Susanti, and Ilham Pebrian	2025	Digital Transformstion in Education

3.2. Discussion

3.2.1 Mindfulness Enhances Digital ELT Engagement

Digital learning environments expose students to multiple distractions notifications, multitasking, and passive screen engagement. Research shows that mindfulness supports learning by improving sustained attention (Shapiro, 2020), lowering anxiety during online speaking tasks (Mercer & Gregersen, 2020), and helping learners regulate emotions during high-cognitive-load activities.

Mindfulness strategies effective in digital ELT. Mindful breathing before online classes Reduces pre class stress and promotes readiness. Visual attention cues Encouraging learners to focus on specific digital elements. Screen time regulation tasks Setting intentional boundaries and reflective journaling. Mindful listening practices. During online speaking and listening sessions. Mindfulness does not only enhance focus but also stabilizes learners' emotional experiences, making digital ELT environments more conducive for deep learning.

3.2.2 Meaningful in Technology Enhanced ELT

According to Jonassen (2000), meaningful learning arises when learners are engaging in authentic, contextualized tasks, construct knowledge actively, relate concepts to real-world applications. Digital tools significantly enhance meaningful learning through Project-Based Learning (PBL). Students produce podcasts, video reflections, and collaborative writing via Google Docs, Padlet, or Flipgrid. Authentic Communication is the telecollaboration projects allow interaction with global peers (Dooly & O'Dowd, 2018). Multimodal Learning Videos, infographics, digital narratives help learners access content through multiple channels.

AI tools like Grammarly, QuillBot, or ChatGPT provide language support and allow deeper reflection and editing. Meaningful learning shifts digital ELT from *consumption* to *creation*.

3.2.3 Joyful Learning and Motivation in Digital ELT

Joyful learning activates positive emotions that enrich cognitive processing (Fredrickson, 2001) and increase long-term motivation. Digital features that promote joy are Gamification such as points, levels, badges (Kahoot, Quizizz), Creative digital storytelling is using Canva, Clipchamp, interactive simulations are virtual worlds, avatars, role-play apps, and the Collaborative games: breakout rooms with challenges. Joyful learning boosts engagement and fosters resilience in challenging tasks such as speaking or writing.

Another challenge stems from the uneven quality of digital learning experiences during the global expansion of online education. While some learners benefit from the flexibility and autonomy of digital environments, others struggle with disengagement,

isolation, and difficulty maintaining motivation. Several research studies conducted between 2018 and 2025 show a rising interest in digital ELT innovation, as illustrated by the increasing number of publications. However, despite the positive trend, many of these studies emphasize technological tools rather than holistic well-being approaches. Therefore, a more comprehensive synthesis is required to understand how technological innovation can be balanced with pedagogical values that foster a supportive and enriching learning environment.

4. CONCLUSION

This literature review highlights the importance of integrating mindfulness, meaningful learning, and joyful learning in digital ELT environments. As technology continues to reshape education, teachers must adopt human-centered pedagogical approaches to maintain emotional balance, cognitive depth, and learner motivation. The study offers a conceptual model and practical strategies that educators can implement in online, hybrid, and technology-rich classrooms. Future research may explore quantitative measurements of joy and mindfulness in digital ELT, or test the conceptual model empirically. The findings offer insights for educators, curriculum designers, and policymakers to reimagine English language education as a transformative process for naturing well-being, engagement, and lifelong learning.

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Education in The Era of Society 5.0: A Critical Pedagogical Approach

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ABSTRACT

Challenges in the era of society 5.0 cause to changes in role of the education system, requiring the strengthening of critical pedagogy for students and teachers. Critical pedagogy is a philosophy of pedagogy and a social movement founded on the ideas of critical social theory and paradigm. The purpose of this study is to review literature on the implementation of critical pedagogy in the education system. The research method used is qualitative literature review approach, literature search using garuda database, sciencedirect, sage journal, taylor & francis. The results of the study show that there are 11 of critical pedagogy in the education development system: (1) critical pedagogy in the development of education systems, learning and new curricula, (2) critical pedagogy moves in the relevance and transformation of education systems, (3) critical pedagogy supports teacher professional, (4) critical pedagogy in the advancement of the digital age and digital literacy, (5) critical pedagogy as language and intercultural communication, (6) critical pedagogy in formal and informal mixed learning, (7) critical pedagogy towards the advancement of STEM (science, technology, engineering, and mathematics), (8) critical pedagogy as a dimension of consciousness and critical dialogic processes, (9) critical pedagogy as creativity, innovation and Interpreneurship, (10) critical pedagogy in disaster mitigation, (11) critical pedagogy as action research. Critical pedagogy greatly supports the education system in developing learning processes teachers and students. This study can be used as a review that critical pedagogy plays a very important role in the education system in the era of society 5.0.

Keywords: *Critical pedagogy, Education, Era Society 5.0, Learning*

1. INTRODUCTION

A breakthrough in information and communication technology, the shift in the society 5.0 period has affected many aspects of human life, including education. The idea behind society 5.0 civilization is a human-centered civilization supported by the integration of advanced physical and digital spaces. In every aspect of life, including education, the emergence of society 5.0 civilization presents new difficulties, including learning. Teachers and students work together to create learning plans during the active learning phase (Afwan et al., 2025; Majid et al., 2023). In the era of society 5.0, education plays an important role in preparing the younger generation to face the challenges posed by an increasingly advanced and complex technological landscape (Nafisah & Muaddab, 2023).

Education is the basic pillar of a country's development, equipping the younger generation with the knowledge and skills needed to become smart citizens and future leaders. To face the challenges of Smart Society 5.0, education has an important role and influence in improving the quality of human resources. In addition, several elements

and stakeholders such as community organizations, the government as a policy maker, and various layers of society also have a role in responding to the Smart Society 5.0 era (Indra, 2024). In this case, the many challenges faced due to the digitalization civilization, it is very important how quality education shapes the character of the younger generation.

To realize quality education, teachers play an important role in shaping students in facing various challenges of digitalization. A teacher has skills and competencies in shaping students who are characterized, responsible, and have very good hopes for the future. However, the fact is that the civilization of society 5.0 causes teachers to be versatile and responsive in facing various challenges, one of which is the emergence of artificial intelligence (AI). This causes teachers to have more comprehensive competencies regarding pedagogy that will support learning development.

Pedagogy is a core and unifying component in the study of education, which brings basic disciplines and other subjects into the study of practice, as well as into the initial education and professional development of teachers (Deng, 2024). In this case, pedagogy acts as a learning development that is adapted to changes and technological advances. According to Sulaiman et al. (2022), there is a relationship between teachers' pedagogical beliefs and the comprehensive use of technology that can be applied in teaching. Therefore, the role of pedagogy in supporting the development of learning in education can be improved as one of the basic strengths of education.

Critical pedagogy is an educational philosophy and social movement based on critical social theories and paradigms. It is an integral aspect of education and culture (Luitel et al., 2022). Critical pedagogy in education not only improves students' intelligence, but more importantly, transforms them into ideal human beings. With education, teachers can help students become independent and mature. Because students hone all their talents ready for the future. According to critical pedagogy, education is essentially a process connected to norms and power processes. Groups or governments can utilize education as a strategy to maintain power (Baharizqi et al., 2023). Applying critical pedagogy can provide sufficiency for learners to become active and critical human citizens, with an ethos of re-examining and reconstructing existing curriculum and pedagogy.

Critical pedagogy aims to make people aware of oppression by awakening them to critical thinking (i.e., something can be seen or intuited). When critical consciousness is achieved, it encourages students, teachers, researchers, and communities to make changes in their context through social critique and political action in order to become who they want to be. Therefore, critical pedagogy does not set a static model, but rather includes practitioners to multimodality according to their context (Gray, 2022; Kumar, 2021; Luitel et al., 2022). The role of critical pedagogy can be used as a basis for

implementing learning development with the challenges of technological advances in the era of society 5.0.

Critical pedagogy embodies the interdependent roles of teachers and students. Critical pedagogy can broaden its scope and foster a more symbiotic relationship between formal education and lifelong learning (Skelton, 2023). However, in reality, there is still a lack of literature that explicitly positions critical pedagogy as an analytical and practical framework in educational development facing the era of society 5.0, where the role of critical pedagogy is still underutilized in the learning process in technological innovation. Therefore, it is very important that critical pedagogy can be used as digital literacy because it can encourage students to develop critical awareness and integral results based on digital information and content. Based on the above issues, the purpose of this study is to review the literature on implementing the role of critical pedagogy in the development of educational learning in the era of society 5.0. This study reviews whether critical pedagogy can function as an ethical and ideological framework in the use of technology in education. This can be a first step in the important role of critical pedagogy in supporting the success of education.

2. METHODOLOGY

This study uses a systematic literature review approach to analyze research on critical pedagogy in the development of the education system. The purpose of this literature is to implement critical pedagogy in educational practice. The literature search was conducted in four main databases, namely Garuda, ScienceDirect, Sage Journal, and Taylor & Francis, on the implementation of critical pedagogy in learning development in the era of Society 5.0. The literature review search used the keywords “Critical pedagogy,” “Era Society 5.0,” “Learning Development,” and “System education.”

To conduct a systematic review search, PRISMA (Preferred Reporting Items for Systematic Review and Meta-analyses) was used. The selection process resulted in 30 articles that met the inclusion criteria and were relevant to the focus of critical pedagogy. The criteria for articles were in Indonesian and English, ful text published in the last 5 years from 2020 to 2025. The data is explained in Figure 1.

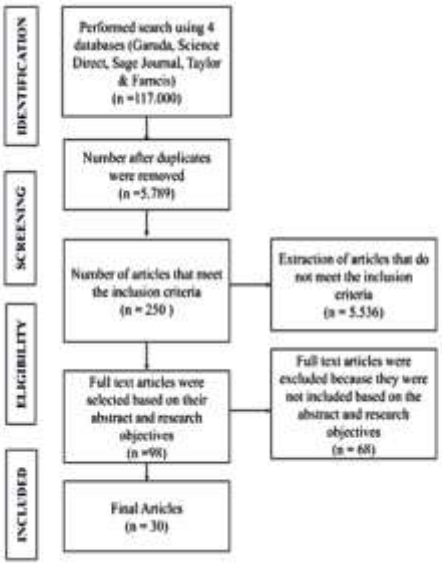

Figure 1. Article Review Process with PRISMA Method

3. RESULT AND DISCUSSION

Based on the results of the literature review, 30 articles were obtained that have been analyzed using the systematic review method which has been grouped according to the role of critical pedagogy. The following are the results of the literature review in Table 1.1.

Table 1. Literature Review

No	Article	Aspect	Details Research Results
Critical Pedagogy in the Development of New Education, Learning and Curriculum Systems			
1	Fajardo-Dack et al., (2024)	Curriculum Policy Analysis Based on Critical Pedagogy Perspective	Critical pedagogy provides opportunities for students to provide flexibility, freedom in learning so that students can express their skills according to their abilities.
2	Hadiansyah & Muhtar, (2023)	The Role of Futuristic Pedagogy in Supporting the New Curriculum.	Futuristic pedagogy can be realized in the educational climate to support the independent curriculum of learning as a multidimensional being in life, developing the potential of learners, providing breadth to adapt to the curriculum, flexible learning with technological frameworks.
3	Baharizqi et al., (2023)	Critical Pedagogical Competence in the Era of Society 5.0	Critical pedagogy guides teachers to create meaningful learning. Teachers must be able to in various skills such as academic cognitive, social, cultural and pedagogical.
4	Hunaepi et al., (2024)	Critical Pedagogy and Student Learning Outcomes	Critical Pedagogy significantly improves educational outcomes and student engagement, advocates for democratic values and social justice.

No	Article	Aspect	Details Research Results
5	Humaeroh et al., (2021)	Critical Pedagogics in Building Humanist Education	Humanist education and critical pedagogy emphasize an educational process that humanizes people. Students are the main actors in the educational process. And the teacher acts as a mediator, facilitator, and motivator in the learning process.
6	Siswadi (2023)	Critical Pedagogy and its Relevance to the Development of the Education System in Indonesia	Critical pedagogy has a view of dismantling forms of formalism and religious fundamentalism in education by restoring democracy in education in Indonesia.
7	Maddamsetti, (2023)	Penerapan Proses Pembelajaran Berdasarkan Pedagogi Kritis	Implementation of Learning Process Based on Critical Pedagogy
8	Qoyyimah et al., (2022)	Critical Pedagogy to Develop Students' Writing Skills	Principles of critical pedagogy such as historicity, problem-solving, emancipation, and dialogic, and have implications that promote critical thinking.
9	Yosia (2023)	Critical pedagogy is the key to education	Critical pedagogy, in the form of independence education, has three implications, namely: sustainable, integrative, and free from elitism.
Critical Pedagogy in Relevance and Transformation of Education System			
10	Nugraha et al., (2024)	Critical Pedagogy in Educational Transformation	Freire's critical pedagogy, there is a critical interpretation of the educational process of the current school system, practicing teaching strategies based on freedom, curriculum planning, and the possibility of transformation into teacher and student roles.
11	Mones et al., (2022)	Critical Pedagogy as Legitimization of Educational Freedom and Transformation in Free Learning	Critical pedagogy emphasizes learning that liberates both politically and socially, humanizing oppressed humans, while the independent curriculum views teachers as professionals who have the authority to work autonomously, based on the science of education.
12	Muhtar, (2020)	The Relevance of Critical Pedagogics in Education in the Era of Industrial Revolution 4.0	Education according to critical pedagogics is not only about making students smart but the most important thing is to make them full human beings. Teachers can make students into independent and mature human beings through education.
13	Valls-Carol et al., (2022)	Critical Pedagogy that Transforms Reality	Critical pedagogy is highly advantageous in that firstly it can achieve broad and deep real transformation, secondly the social impact of the work, especially on the oppressed,

No	Article	Aspect	Details Research Results
			overcoming inequality and improving their living conditions. Third is the equality of outcomes of the oppressed in literacy as well as sentiments and values, without segregation. The fourth is the theoretical and scientific rigor of their contributions
Critical Pedagogy Supports Teacher Professional Development			
14	Syabaruddin et al., (2023)	Critical Pedagogy in the Digital Age	Critical pedagogy seeks to reduce the authoritarian tendencies of education. Critical pedagogy is considered to have a profound impact on the advancement of democracy.
15	Apriyanto et al., (2021)	The Role of Critical Pedagogy in Digital Literacy	The results of the analysis show that digital literacy has a significant influence on students' critical pedagogical understanding ability. This can be used as a reference to improve the quality of students' critical pedagogical understanding.
16	Pikhart et al., (2022)	Application of Critical Pedagogy in Digital Second Language Acquisition	The important role of critical pedagogy in building students' personalities socially and scientifically as one of the main elements in the learning process.
17	Robandi et al., (2022)	Critical Pedagogy Based on Digital Learning and Big Data in Improving Digital Literacy	In-depth critical pedagogic-based learning encourages service activities designed in the form of public discussions and sharing experiences in the field about the effectiveness of organizing digital literacy movements in educational institutions.
Critical Pedagogy in the Advancement of the Digital Age and Digital Literacy			
18	Akinsanya & Ojotule, (2022)	Critical Pedagogy and Professional Teaching	Critical pedagogy can be of great benefit to teaching practice in this century. It has enormous comparative advantages that are particularly important for today's teachers and learners.
19	Sullivan, (2021)	A Critical Pedagogy and Teacher Professional Development	Practical actions that teachers can take to develop their ability to engage in critical pedagogy, providing suggestions on how such work can be improved, especially with regard to the discussion of equity for teachers and students.
20	Rodés et al., (2021)	Teacher Professional Development Strategy Based on Critical Digital Pedagogy and Pedagogy of Care	The critical pedagogy initiative ends up being an enriching alternative to the Teacher Professional Development approach, emphasizing its relevance in the context of a rapid response to the transition to Emergency Distance Teaching.
21	Vavitsas, (2022)	The Role of Critical Pedagogy in	The role of critical pedagogy impacts positive attitudes and positive intellectuals on

No	Article	Aspect	Details Research Results
		Education: Exploring the Views of Greek Teachers	teachers while developing the education system.
Critical Pedagogy as Language and Intercultural Communication			
22	Febrianti, (2024)	The Role of Critical Pedagogy to Build Social Awareness in Language and Literature Learning	The application of critical pedagogy in language and literature learning can increase students' social awareness by linking literary and language texts with social contexts.
23	Wang & Yuan, (2024)	Integrating Critical Pedagogy into Second Language Teacher Education	The role of critical pedagogy in catalyzing the transformation of student teachers' identities into linguistically inclusive, socially conscious, and culturally responsive language teachers. Practical implications are also provided in this study.
24	Corbett & Guilherme, (2021)	Critical Pedagogy and Quality Education (UNESCO SDG-4): Paulo Freire's Legacy for Language and Intercultural Communication	Critical Pedagogy's role as an overcoming of oppression, hope and dignity is still very relevant and inspiring for educational practices around the world.
Critical Pedagogy as Formal and Informal Blended Learning			
25	Smith & Seal, (2021)	Critical Pedagogy in Informal Learning	Critical pedagogy is essential for the teaching of informal educators, allowing teachers and practitioners to stop the hegemony of neo-liberal and neo-managerial thinking in their practice and in education.
Critical Pedagogy Towards Progress STEM (*(Science, Technology, Engineering, and Mathematics)*			
26	Alvidrez et al., (2024)	The Role of Critical Pedagogy in Education Toward STEM *(Science, Technology, Engineering, and Mathematics)*	Contextualizing critical pedagogy more broadly and its emphasis on social justice, this research underscores the transformative potential of education in shaping the future of minority students in STEM disciplines.
Critical Pedagogy as a Dimension of Consciousness and Critical Dialogical Processes			
27	Semadi (2022)	Critical education paradigm in the dimension of critical consciousness and critical dialogical process	The development of critical education is an effort of self-awareness, or also called critical consciousness, as time develops its main learning method by emphasizing the principle of critical dialogical dominance.
Critical Pedagogy as Creativity, Innovation and Interpreneurship			
28	Marliyani & Muhtar, (2022)	Creativity, Innovation, and Interpreneurship in Critical Pedagogy	Critical pedagogy positions interpreneurship as part of efforts to change the socio-economic conditions of society.

No	Article	Aspect	Details Research Results
			Interpreneurship is driven by creativity and innovation which is an expression of students' critical consciousness.
		A Critical Pedagogy in Disaster Mitigation	
29	Ferani Mulianingsih, (2024)	Critical Pedagogy of Disaster Mitigation in Social Studies Learning	Critical pedagogy can be applied with the awareness of the community, both students and teachers. An awareness of potential flood disasters and flood disaster mitigation through critical pedagogy.
		Critical Pedagogy as Action Research	
30	Aliyah et al., (2023)	Critical Pedagogy Pradigm in Action Research	Critical pedagogy extends the meaning of pedagogy into the paradigm of life, which is the view that a person has deeply about his or her relationship with the world and others.

From the results of the literature review, several groupings of implementation of the role of critical pedagogy in the development of learning education systems were obtained. In the current conditions of development of the information society, the spread of mass culture, the transformation of spiritual values, as well as the loss of a sense of security and protection of humanity from natural disasters and other global threats, an important innovative challenge is the study of the classical methods of scientific knowledge of reality, methodology and practice of critical pedagogy. Critical pedagogy is usually associated with the name of the former Brazilian Minister of Education, Paulo Freire, who in the 60s of the 20th century proposed the concept of proper education based on freedom and critical thinking in this field. Freire's critical pedagogy promoted problem-oriented education, anthropological interpretation of culture, the concept of humanity, critical consciousness, and modeling of educators' ideals. This theory quickly spread in different countries of the world, because in the mid-20th century, an active movement for social equality, and freedom from various types of oppression, oppression due to political, economic, or social factors began in the world. In Europe, in particular, it meant the struggle against the dictatorships of fascism and Stalinism, and this, in a way, gave rise to critical trends in science and education (Budnyk, 2023; Luitel et al., 2022).

Critical pedagogy has a very important role in supporting the sustainability of life, especially in the field of education, education is the spearhead of change in future progress. So that the existence of this education does not change due to technological civilization which can cause a lack of teaching process between teachers and students, critical pedagogy plays a role in strengthening the education system. Critical pedagogy provides insights to oppose and criticize the phenomena that occur, because it can create a more just world regarding education, and welfare to anyone who is entitled to receive education (Güneş, 2020). So that the role of critical pedagogy is not only a

philosophy but can be used as a basis for implementation in the education development system.

There are eleven roles of critical pedagogy in supporting the progress and development of learning in the era of society 5. These include, (1) Critical Pedagogy in the Development of Education Systems, Learning and New Curricula, (2) Critical Pedagogy Moves in the Relevance and Transformation of the Education System, (3) Critical Pedagogy Supports Teacher Professional Development (4) Critical Pedagogy in the Advancement of the Digital Age and Digital Literacy, (5) Critical Pedagogy as Language and Intercultural Communication, (6) Critical Pedagogy in Formal and Informal Blended Learning, (7) Critical Pedagogy Towards STEM (Science, Technology, Engineering, and Mathematics) Advancement, (8) Critical Pedagogy as a Consciousness Dimension and Critical Dialogical Process, (9) Critical Pedagogy as Creativity, Innovation and Interpreneurship, (10) Critical Pedagogy in Disaster Mitigation, (11) Critical Pedagogy as Action Research.

1. Critical Pedagogy in the Development of Education System, Learning and New Curriculum

Critical pedagogy guides teachers to create meaningful learning. Teachers must have the ability to think critically Critical pedagogy can be well developed in the development of the education system as a learning model that can be carried out by students in the classroom such as having freedom, flexibility in learning and having critical thinking skills (Baharizqi et al., 2023; Fajardo-Dack et al., 2024; Hunaepi et al., 2024; Siswadi 2023). Students are not only required to be versatile but are involved in everything to express their skills and abilities, so that there is collaboration in the learning system because students and teachers are able to involve each other in learning through critical pedagogical. According to Humaeroh et al., (2021) students are the main actors in the educational process. As the main player, the teacher acts as a mediator, facilitator, and motivator in the learning process. In this case, critical pedagogy can be used as a basic reference in the development of education as a form of humanizing humans through learning in the classroom. The principles of critical pedagogy such as historicity, problem-solving, emancipation, and dialogic are evident in this study. And has implications that promote critical thinking By realizing the achievement of critical pedagogical understanding, teachers can create learning with various learning models that are able to involve students in the classroom (Baharizqi et al., 2023; Qoyyimah et al., 2022).

Critical pedagogy significantly improves educational outcomes and student engagement, advocating for democratic values and social justice. This makes critical pedagogy a catalyst in involving teachers and students in learning in democracy and social justice (Hunaepi et al., 2024). To fulfill the implementation of the role of critical

pedagogy, very careful planning is needed in developing the education system through several stages, namely learning planning, learning implementation, and learning evaluation (Maddamsetti, 2023). These three things become the basis for every development of the education system through critical pedagogy to be structured and systematic, this increases the learning process that occurs in the classroom to be effective and successful in implementing. To support the design of a good education system, it is necessary to use the curriculum as a guide in the learning process. This is supported by Hadiansyah & Muhtar, (2023) that pedagogifuturistic can be realized in the educational climate to support the existence of an independent curriculum learning as a multidimensional being in life, developing the potential of students, The development of an independent curriculum is inseparable from the role of pedagogy as the basis for learning

Critical pedagogy in realizing education in accordance with the merdekat curriculum has three implications, namely: sustainable, integrative, and free from elitism (Josiah 2023). The three implications can be applied in the education system through critical pedagogy, the first is sustainable where the curriculum as a guide must be able to maintain and improve a better learning system by not eliminating aspects of learning that have been linked in the previous curriculum. Second, integrative, which must be able to combine a unified whole in learning that is integrated with an independent curriculum. Third, education is a right for everyone, in this case there is no power over power in realizing quality education, by not abusing authority in developing the education system. So in this case, the role of critical pedagogy can perfect the formation of a curriculum that follows technological progress and civilization. In the era of society 5.0, it is necessary to develop a quality education system by emphasizing the competence of critical pedagogy to teachers as student facilitators, so that critical pedagogy plays an important role during the learning process that will not be timeless.

2. Critical Pedagogy Moves in Relevance and Transformation of the Education System

Critical pedagogy is formed and developed in the education system because it is relevant, and transformation to change the reality of education. Critical pedagogy has a strong connection in supporting the development of education, because critical pedagogy becomes a refinement in learning activities. According to Muhtar, (2020) critical pedagogy is not only making students smart but the most important thing is to make them a full human being. Teachers can make students become independent and mature human beings through education. Because students develop the potential to live in the future. In this case, critical pedagogy becomes very relevant to the education system, because critical pedagogy can encourage learning that improves the ability to think critically, is sensitive to social situations and can take action to change in learning.

Freire's critical pedagogy, there is a critical interpretation of the educational process of the current school system, practicing teaching strategies based on freedom, curriculum planning, and the possibility of transformation into the role of teachers and students. Students need to have a critical pedagogy method that can move forward by building relationships between students and their environment (Nugraha et al., 2024). It is emphasized that the role of critical pedagogy becomes correlated in a better education system in accordance with 21st century learning in the era of digitalization of society 5.0.

Structural changes in education are called educational transformation. Educational transformation will continue to develop following the changes and civilization of the times. Critical pedagogy is a strengthening of educational transformation in developing a more improved and quality education system. Critical pedagogy learning according to Mones et al., (2022) emphasizes learning that liberates from both political and social aspects, humanizing oppressed humans, while the independent curriculum views teachers as professional workers who have the authority to work autonomously, based on educational science. This is in accordance with research conducted by Valls-Carol et al., (2022) that critical pedagogy is very beneficial, first, it can achieve broad and deep real transformation, second, the social impact of work, especially on the oppressed, overcoming inequality and improving their living conditions. The third is the equality of outcomes of the oppressed in literacy as well as sentiments and values, without segregation. The fourth is the theoretical and scientific rigor of their contributions to learning (Valls-Carol et al., (2022). The stages of critical pedagogy as an educational transformation present teachers' attitudes and professionals in learning with students. This critical pedagogy as an educational transformation becomes strong in encouraging change and development of a better education system.

3. Critical Pedagogy Supports Teachers' Professional Development

Critical pedagogy can greatly benefit teaching practice in this century. Pedagogy has a huge comparative advantage that is very important for teachers and learners in this day and age (Akinsanya & Ojotule, 2022). Critical pedagogy is very supportive of teacher professionalism because the teacher is a facilitator, motivator, in learning conducted with students, besides that the teacher plays an active role regarding the learning process from beginning to end in the classroom. Good teacher understanding can be improved through critical pedagogy competencies, because teachers must have more ability to think critically, analyze, and take action in the learning process.

The critical pedagogy initiative ends up being an alternative that enriches the Teacher Professional Development approach, emphasizing its relevance in the context of a rapid response to the transition to Emergency Distance Teaching (Rodés et al.,

2021). Distance teaching can also be taken seriously if teachers already have critical pedagogy competencies, because under any circumstances a teacher will still try and strive for the learning process to be carried out very well. This reinforces that teachers can be professional during teaching because they have good abilities in applying critical pedagogy in professionalism in learning. The role of critical pedagogy has a positive attitude and positive intellectual impact on teachers while developing the education system (Sullivan, (2021).

Practical actions that teachers can take to develop their ability to engage in critical pedagogy, provide suggestions on how the work can be improved, especially with regard to discussions about equality for teachers and students (Vavitsas, 2022). Teacher professional developers support the development of the education system through critical pedagogy, because critical pedagogy encourages teachers to develop meaningful learning processes for students in the classroom. In addition, learning based on critical pedagogic makes teachers have competencies that will continue to develop into professional teachers, changing times will not be a barrier because professional teachers have a way to always improve the learning process in developing a quality education system in the era of society 5.0.

4. Critical Pedagogy in the Advancement of the Digital Age and Digital Literacy

The challenges of changing times are inseparable from the digital era, increasingly here will continue to develop related to advances in digitalization. It is undeniable that readiness in the learning process must be better and needs to be improved, so that the process does not stop due to changing times. The important role of critical pedagogy in building students' personalities socially and scientifically as one of the main elements in the learning process. The critical pedagogy approach fosters tolerance for various cultural viewpoints, increases social and political awareness, and fosters moral behavior related to social and political integrity and can be used to maintain student construction within or against conventional conceptual views (Pikhart et al., 2022).

Critical pedagogy is present as a guide and reference in the learning process of the digitalization era, because critical pedagogy will continue to improve the learning development process through digital literacy. Even the results of the analysis conducted by Apriyanto et al., (2021) show that digital literacy has a significant effect on students' critical pedagogy understanding ability. This can be used as a reference to improve the quality of students' critical pedagogical understanding. In-depth critical pedagogy-based learning encourages service activities designed in the form of public discussions and sharing experiences in the field about the effectiveness of organizing digital literacy movements in educational institutions. Critical pedagogy as digital literacy seeks to reduce the tendency of authoritarian education. In addition, critical

pedagogy is considered to have a profound impact on the progress of democracy because it can encourage citizens to think critically, have broad insights, make judgments, and take responsibility for their actions (Robandi et al., 2022; Syabaruddin et al., (2023).

5. Critical Pedagogy as Language and Intercultural Communication

Critical pedagogy plays a role in language and intercultural communication, because it is a learning tool in improving educational development. The application of critical pedagogy in language and literature learning can increase students' social awareness by linking literary and language texts with social contexts. Students can be more critical in understanding the dynamics of power intertwined in language and more reflective of the surrounding social conditions (Febrianti, 2024). Critical pedagogics as language has positive implications for the formation of educational development because language can improve the communication that exists between teachers and students. The role of critical pedagogy in catalyzing the transformation of student-teacher identity into linguistically inclusive, socially aware, and culturally responsive language teachers (Wang & Yuan, 2024). Language that makes a catalyst allows teachers to play an active role in communicating forms of learning in educational development,

Critical pedagogy acts as communication in overcoming oppression, hope, and dignity is still very relevant and inspiring for educational practices around the world. And asserts that the future cannot be determined a priori, as a condition that learners are expected to adapt to (Corbett & Guilherme, 2021). Critical pedagogy, which acts as language and intercultural communication, is very powerful in maintaining communication in learning. Good communication is needed in the era of society 5.0 so as not to be defeated by technological sophistication, the more good communication is carried out by teachers to students, the more sustainable learning will be created, this happens because of the teacher's ability to link the role of critical pedagogy to the learning carried out in the classroom.

6. Critical Pedagogy in Formal and Informal Blended Learning

In learning education there are usually several parts, in addition to formal education received at school there is usually informal education. Informal education usually emphasizes rights and freedoms in learning. According to Smith & Seal, (2021) critical pedagogy is essential for the teaching of informal educators, which allows teachers and practitioners to stop the hegemony of neo-liberal and neo-managerial thinking in their practice and in education, and reorient themselves and examine their position in their institutions. In this case, it can be seen that informal education has an interest in strengthening educational development learning, such as soft and hard skills

training for students including leadership training, discipline, skills, and so on that support students to play a more active role in the learning process through critical pedagogy.

7. Critical Pedagogy Towards STEM (Science, Technology, Engineering, and Mathematics) Advancement

Critical pedagogy is not only supportive as learning but in other contexts critical pedagogy is involved in the development of natural science in the education system. The broader context of critical pedagogy and its emphasis on social justice, this research underscores the transformative potential of education in shaping the future of minority students in STEM disciplines (Alvidrez et al., 2024). Minority students in studying STEM can have an impact on their knowledge, so the role of critical pedagogy can encourage the development of developmentally appropriate learning about STEM, because the use of STEM is closely related to daily life and can also affect students' thinking for the future.

8. Critical pedagogy as a dimension of awareness and critical dialogical process

Awareness and critical dialogic are the concepts of critical pedagogy. Critical awareness of how in every learning process we can reflect and analyze critical situations. While critical dialogue is how we carry out a good communication process with open and directed dialogue in the learning process to build critical awareness. The development of critical education is an effort of self-awareness, or also called critical awareness, as time develops its main learning method by emphasizing the principle of critical dialogical domination (Semadi, 2022). Learning methods that emphasize the concept of critical pedagogy through critical awareness and dialogue can be perfect in supporting critical thinking between teachers and students. This learning development can improve the education system in the era of society 5.0, there is no fear in facing developments because in the process students and teachers can be trained with critical pedagogy.

9. Critical Pedagogy as Creativity, Innovation and Interpreneurship

The role of critical pedagogy is very widespread in supporting the learning process in every field. Critical pedagogy not only forms characters who think critically, responsibility, but the emergence of critical pedagogy can increase creativity, innovation, and interpreneurship. According to Marliyani & Muhtar, (2022) critical pedagogy positions interpreneurship as part of efforts to change the socio-economic conditions of society. Interpreneurship is driven by creativity and innovation which is an expression of students' critical consciousness (Marliyani & Muhtar, 2022). In this case, strengthening the role of critical pedagogy does not only move learning in schools but

makes learning development materials for future provision in knowing socio-economics as a form of critical awareness of students in the education system.

10. Critical Pedagogy in Disaster Mitigation

The role of critical pedagogy in education will continue to grow, even continue to increase with various problems. Critical pedagogy forms a person in the ability to assess, analyze, and implement. Critical pedagogy can be applied with the awareness of the community, both students and teachers. Awareness of potential flood disasters and flood disaster mitigation through critical pedagogy can be implemented in Social Science learning (Ferani Mulianingsih, 2024). One of the specific roles in the development of Social Science learning is that critical pedagogy moves in disaster mitigation learning, where students are expected to learn in critical awareness of how to cope with disasters, the more their knowledge is nurtured, the stronger they will survive in their lives. Students play a role in the progress of the nation in the future, the milestone of change in goodness is in students, so critical pedagogy can build better student roles and characters and not be shaken by changing times, but continue to develop and transform for the better through learning conducted in the classroom with the teacher.

11. Critical Pedagogy as Action Research

Critical pedagogy expands the meaning of pedagogy into the paradigm of life, which is the view that a person has deeply about his relationship with the world and others. Critical pedagogy has power relations in society, which leads to a certain social model (Aliyah et al., 2023). In the development of education, we must always review the problems caused through a research study. Research is conducted to find solutions in dealing with existing problems. Every problem that exists becomes a benchmark for how to take better action. Critical pedagogy does not only play a role in learning but as an action research phrase, namely action research, action review, and action research. Where every action based on critical pedagogy can make a better change in every educational development process, so that education becomes more improved and more qualified to be accepted by students around the world.

4. CONCLUSION

Critical pedagogy is not about the learning process but developing the fundamental thinking capacity of students and teachers and bringing about behavioral changes in their ways of doing, being students who see and examine teaching and learning systems. The role of critical pedagogy is very supportive in the process of developing the education system in the era of society 5.0. There are eleven role implementations that can be applied including; (1) Critical Pedagogy in the

Development of Education Systems, Learning and New Curricula, (2) Critical Pedagogy Moves in the Relevance and Transformation of the Education System, (3) Critical Pedagogy Supports Teacher Professional Development, (4) Critical Pedagogy in the Advancement of the Digital Age and Digital Literacy, (5) Critical Pedagogy as Language and Intercultural Communication, (6) Critical Pedagogy in Formal and Informal Blended Learning, (7) Critical Pedagogy Towards STEM (Science, Technology, Engineering, and Mathematics) Advancement, (8) Critical Pedagogy as a Consciousness Dimension and Critical Dialogical Process, (9) Critical Pedagogy as Creativity, Innovation and Interpreneurship, (10) Critical Pedagogy in Disaster Mitigation, and (11) Critical Pedagogy as Action Research.

The eleven roles of critical pedagogy are the basis for examining deeply rooted values, beliefs and assumptions that may challenge the education system. In this case, it is necessary to strengthen the role of critical pedagogy in the learning process in developing the education system. Critical pedagogy potential is needed for all teachers who teach, critical pedagogy as a way of teaching that encourages teachers to invite students to think critically about the deep structure of things about the future and hope. Changes and developments in the times will continue to develop, education must continue and prevent character changes in students through strengthening critical pedagogy. This research can be used as a reference material for further researchers in applying critical pedagogy in the education system in the era of society 5.0.

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Simkah 4.0 From The Perspective of Tam: The Dilemma of Technology and Digital Pedagogy Integration for Office of Religious Affairs

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ABSTRACT

Digital curriculum innovation within the scope of the Ministry of Religious Affairs in the Office of Religious Affairs (KUA) refers to a technology-based learning framework to improve the quality of public services in the religious field, including premarital counseling and digital literacy. This qualitative study analyzes the challenges of technology integration in the public education ecosystem through a case study of the acceptance of SIMKAH 4.0 (the Ministry of Religious Affairs' digital innovation) by Marriage Registrars (PPN) or Penghulu. This study uses the Technology Acceptance Model (TAM) framework, specifically Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), to identify functional barriers that affect the educational role of Penghulu. The case study was conducted in Hulu Sungai Utara, South Kalimantan, through in-depth interviews. Informants were selected based on their willingness, good technical mastery of SIMKAH, and direct involvement in public service interactions. Interviews were conducted with the Head of the Sungai Tabukan OFFICE OF RELIGIOUS AFFAIRS and a staff at member Office Of Religious Affairs (KUA) Banua Lawas employees as key informants. The findings show a dilemma of high SIMKAH PU integration (administrative efficiency) but low PEOU among senior staff and the public. Low public PEOU forced the Office Of Religious Affairs (KUA) to take over data input, which significantly eroded the Penghulu's time for Digital Pedagogy tasks (pre-marital guidance). The success of technology integration is highly dependent on the implementation of a systematic Digital Curriculum Model to bridge the literacy gap. The result is the formulation of a strategic Digital Curriculum Model for Office Of Religious Affairs (KUA) to ensure that SIMKAH 4.0 fully supports Educational Transformation in marriage services.

Keywords: *Digital Literacy, Digital Pedagogy, Office of Religious Affairs (KUA), SIMKAH 4.0, Technology Acceptance Model (TAM).*

1. INTRODUCTION

Digitalization in the integration of technology in public education in Indonesia continues to accelerate its digital transformation as a fundamental effort to improve the efficiency and transparency of public services. At the Ministry of Religious Affairs (Kemenag), this effort is realized through the modernization of marriage registration services with the Marriage Management Information System (SIMKAH) 4.0, which was launched simultaneously in 2019. SIMKAH 4.0 serves as the backbone of the Ministry of Religious Affairs' technology regarding marriage administration.

The application of this advanced technology not only brings introduces administrative changes but also requires a review of the Digital Curriculum and Pedagogy Model that has been attached to the role of Marriage Registrar (PPN) or Penghulu. (Setiawan & Ma'ruf, 2022). The Penghulu has a critical dual role in the

Ministry of Religious Affairs' Public Education: as a Technology Administrator (responsible for input, verification, and reporting of SIMKAH) and as a Digital Educator (tasked with providing premarital guidance and counseling). The conflict between these two roles is evaluated using the Technology Acceptance Model (TAM) framework. TAM, which focuses on Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), is relevant for measuring system acceptance and identifying whether SIMKAH 4.0 truly functions as an effective educational and administrative tool or actually hinders it.

The central problem often encountered is the digital divide and the urgency of the digital curriculum model of technological innovation promoted by SIMKAH 4.0 faces implementation challenges rooted in the problem of the digital literacy gap, which is a barrier to the integration of technology in public education. Although the system is structurally in place, its acceptance in the field raises the dilemma that high PU (system usefulness) is not followed by uniform PEOU (collective user acceptance) among users. Concerns about the low digital competence of senior Office of Religious Affairs (KUA) staff and the communities they serve have led to operational practices that are not in line with the system design.

This dilemma highlights the failure to formulate an appropriate Digital Curriculum Model for Ministry of Religious Affairs staff and the public. If advanced technology has been provided, but staff and the public do not have adequate training or curriculum to use it independently, then innovation will be hampered and the workload will shift to individuals who are already digitally literate. This is the core of the issue of educational transformation through innovative curricula in the digital age, which is the focus of this study: technology must be integrated with an effective training curriculum model in order to support the optimization of the educational role (Digital Pedagogy) of religious leaders. (Rusli & Harahap, 2024). Based on the above background, this study aims to:

1. Analyze the Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) of SIMKAH 4.0 in determining the level of system acceptance among Penghulu
2. Identify how the implementation of SIMKAH 4.0 creates an integration dilemma between the administrative role and the optimization of the Digital Pedagogy role of Office of Religious Affairs (KUA) or Penghulu
3. Formulate recommendations for a systematic Digital Curriculum Model for training Penghulu competencies in order to bridge the digital divide and ensure that Technology Integration fully supports their educational role

The pinnacle of this innovation was the simultaneous launch of SIMKAH Generation 4 (SIMKAH 4.0) in 2019. This system is designed to achieve high data accuracy, national data integration, and standardization of marriage administration processes throughout Indonesia, thereby ensuring the quality of Islamic Family Law services.

The implementation of SIMKAH 4.0 places Marriage Registrars (PPN) or Penghulu in a key position. They have a dual role: they are responsible for recording and verifying official documents (the technological administrative aspect) while also acting as educators and counselors tasked with providing guidance, advice, and coaching to prospective brides and grooms (the digital pedagogy aspect). This technological integration, although positive in its objectives, creates implementation challenges that require in-depth analysis. The main challenge is to ensure that the adoption of the new digital system does not erode, but rather supports and strengthens the educational role of the Penghulu. This dilemma is often exacerbated by significant digital competency gaps between older and younger Penghulu, resulting in low efficiency for some PPN. If the digital system requires excessive effort or is not perceived to be in line with holistic service performance improvements, it can create dilemmas and suboptimal outcomes, which are the focus of this study.

To analyze the acceptance of the system and this role conflict, this study uses the Technology Acceptance Model (TAM) framework. This model evaluates users' willingness to adopt technology based on two main factors, namely Perceived Usefulness (PU), which is the extent to which Penghulu believe that SIMKAH 4.0 improves work quality, and Perceived Ease of Use (PEOU). PEOU is the perception of the extent to which the Penghulu believes that using SIMKAH 4.0 will be effortless, easy to learn, and intuitive to operate.

By analyzing these two perceptions, it can be identified whether SIMKAH 4.0 is truly accepted as a solution for performance improvement or as an obstacle. Based on this background and theoretical framework, this study formulates the following core questions: First, to what extent do the Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) of SIMKAH 4.0 influence the level of acceptance and adoption of the system by Penghulu? Second, how does the implementation of SIMKAH 4.0 create a dilemma between administrative efficiency and the optimization of the Digital Pedagogy role carried out by Penghulu?

Finally, based on these issues, this study aims to analyze Penghulu's perceptions of PU and PEOU and identify how SIMKAH 4.0 affects the integration between the administrative role and the Digital Pedagogy tasks of Penghulu at the OFFICE OF RELIGIOUS AFFAIRS (Research Objective). This study concludes by formulating recommendations to improve the digital competence of Penghulu and ensure that SIMKAH 4.0 can be a catalyst for their educational role to be optimized.

2. METHODOLOGY

2.1. Research Design

This study employs a qualitative approach with an interpretive case study design to gain a deep understanding (thick description) of the perceptions and dilemmas faced

by Marriage Registrars regarding SIMKAH 4.0. The research focuses on the Technology Acceptance Model (TAM) framework, specifically Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). The study was conducted at the Office of Religious Affairs (KUA) in Sungai Tabukan and Banua Lawas, Hulu Sungai Utara.

2.2. Participants of the Study

The main participants in this study were the Head of the Office Of Religious Affairs (KUA) and Marriage Registrar (PPN) or SIMKAH operator staff. The sampling technique used was purposive sampling, including informants who had direct experience and represented generational comparisons (digital gap). The participants interviewed in depth consisted of:

1. Informant AB, Head of the Sungai Tabukan Office Of Religious Affairs (KUA) or Penghulu
2. Informant D, a staff member at Office Of Religious Affairs (KUA) Banua Lawas (representing operations/the younger generation and system operator)

2.3. Instrument

The main instrument in this qualitative study is the researcher himself (Human Instrument). Supporting instruments include Semi-structured Interview Guidelines designed to explore in depth the perceptions of PU and PEOU SIMKAH 4.0, the challenges of the digital divide, and the impact of the system on the pedagogical tasks of the Penghulu.

2.4. Data Analysis Techniques

The data analysis technique used is Interactive Model Qualitative Data Analysis (Miles, Huberman, & Saldaaa). The stages of analysis include:

1. Data Reduction (sorting interview data relevant to PU, PEOU, and the Digital Curriculum Model
2. Data Presentation (organizing findings into narratives and quotations)
3. Drawing Conclusions or Verification (interpreting findings to answer research questions, particularly regarding the dilemma of technology-pedagogy integration under the TAM framework)

3. RESULT AND DISCUSSION

3.1 Acceptance of SIMKAH 4.0 in the Perspective of the Technology Acceptance Model (TAM): The Dilemma of High PU vs. Low PEOU

The acceptance or registration of *catin* (prospective bride) by Marriage Registrar (PPN)/Penghulu (religious leader) to the Marriage Management Information System (SIMKAH) 4.0 was analyzed using the Technology Acceptance Model (TAM)

framework, which is widely recognized for predicting the acceptance and use of information systems (Davis, 1989). This model focuses on two main cognitive variables: Perceived Usefulness (PU) or the user's belief that using SIMKAH 4.0 will improve their work performance in terms of speed, accuracy, and output quality, and Perceived Ease of Use (PEOU) or the user's belief that using SIMKAH 4.0 will not require much effort, is easy to learn, and is free from technical complications (Wicaksono, 2022). The use of the TAM model in the use of SIMKAH has been carried out in various regions (2024a). An analysis of the findings of the High PU vs. PEOU dilemma, which varied in analyzing the acceptance of SIMKAH 4.0 at the Sungai Tabukan Office Of Religious Affairs (KUA) and a staff at member Banua Lawas Office Of Religious Affairs (KUA), showed that there was a clear dichotomy in Hulu Sungai Utara Regency: PU was recognized as high, but PEOU varied at the implementation level, which then created operational dependence.

The implementation of SIMKAH 4.0 in various Religious Affairs Offices (KUA) consistently confirms the high value of Perceived Usefulness (PU) in terms of administrative efficiency. Other studies show that the functionality of SIMKAH extends beyond marriage, divorce, and reconciliation matters to include data collection on waqf. The success of this program is measured by the achievement of fast, secure, and comprehensive data management, in accordance with the demands of digital public services. Within the framework of the Ministry of Religious Affairs' Education Transformation, the optimization of administrative efficiency serves as a fundamental prerequisite for the goal of minimizing the burden of manual data entry for Penghulu. The time saved through SIMKAH's efficiency is allocated to maximize and implement Digital Pedagogy and develop a Digital Curriculum Model in pre-marriage counseling, thereby reinforcing the role of Penghulu as educators focused on the digital literacy of prospective brides and grooms (Juneldi & Sururie, 2020). This creates a real opportunity to optimize their Digital Pedagogy competencies, which include the use of features such as Digital Marriage Cards and online registration as an integral part of the Digital Curriculum Model in pre-marital counseling. (S. K. Wibowo et al., 2023).

Not only that, this system is fundamentally recognized as improving the efficiency and accuracy of marriage administration. The Head of the Sungai Tabukan Office Of Religious Affairs (KUA), informant AB, even considers this system to be very convenient, which indicates its successful adoption at the leadership level: "It is very convenient because: 1. Marriage data is stored securely, 2. The possibility of errors/mistakes in printing marriage certificates is minimal... 3. For marriage reports to the District Ministry of Religious Affairs, data can be obtained more quickly in Simkah without having to retype it." (informant AB, Head of the Sungai Tabukan Office Of Religious Affairs (KUA)). This benefit is supported by informant D, a staff Office Of Religious Affairs (KUA) Banua Lawas clerk, who emphasizes operational efficiency

because the system eliminates manual work, "It's so easy, it really makes it easier for the Office Of Religious Affairs (KUA) because we no longer have to write by hand." (D, a staff Office Of Religious Affairs (KUA) Banua Lawas clerk). This consensus confirms that technology has successfully addressed the aspect of improving administrative quality, consistent with findings from similar studies on the evaluation of SIMKAH (Mubaarok & Sutedi, 2023).

However, the critical point of this study lies in the varying PEOU among staff and external users, varying PEOU, and the failure of the Low Public PEOU Digital Curriculum Model: Limited digital understanding is evident in the reluctance of prospective brides and grooms to register independently. The head of the Sungai Tabukan Office Of Religious Affairs (KUA) revealed that even though the independent registration feature is available, "no Catin has ever registered independently." This indicates the failure of the Public Education Curriculum Model to improve the PEOU of the community, so that the burden of data input remains with Office Of Religious Affairs (KUA) officials.

On the other hand, the issue of SIMKAH's Perceived Ease of Use (PEOU) is not only rooted in the technical constraints of the Office Of Religious Affairs (KUA), but also in the problem of literacy and the digital divide among the community. The community tends to lack the initiative or motivation to access SIMKAH educational materials independently (e.g., through YouTube or the Office Of Religious Affairs (KUA) website), and even feels unconfident in using technology. This passive tendency causes the community to always wait for instructions from Paciran Subdistrict officers, instead of utilizing the independent online registration feature. This phenomenon underscores the failure of Digital Pedagogy at the public level. Structurally, this low public PEOU forces Office Of Religious Affairs (KUA) officials who should be focused on pre-marital counselling to divert their time back to administrative data entry tasks, which is at the heart of the dilemma of technology integration in public services. (2025).

PEOU low-level senior staff, informant D highlighted the risk of data errors among staff with low PEOU: "The thing is, the old folks can make mistakes, and they can also forget how to do things [if the older folks can click the wrong thing, and they can also forget how to do things]." This concern shows that the Ministry of Religious Affairs' Internal Training Curriculum Model has not been effective in addressing the digital generation gap in competencies, a common challenge in technology integration. (Sari & Hidayat, 2023)

The critical point of this research lies in the varying PEOUs, which creates an urgency to formulate an appropriate Digital Curriculum Model. This raises implementation dilemmas related to the collective digital understanding of the Office Of Religious Affairs (KUA). Although the leadership feels that the PEOU is high, they realize that this mandatory system requires careful handling. Limitations in digital

literacy are evident in the difficulties faced by PPN/senior staff and the reluctance of prospective brides and grooms (Catin) to register independently. The head of the Sungai Tabukan Office Of Religious Affairs (KUA) stated that marriage registration is mandatory through SIMKAH, but no Catin has ever registered independently, indicating low PEOU among the community, so the burden of data input remains with Office Of Religious Affairs (KUA) officials. Furthermore, informant Dina, a staff at the Banua Lawas Subdistrict Office Of Religious Affairs (KUA), highlighted the risk of data errors among senior staff with low PEOU: "The thing is, the old folks can make mistakes, and they can also forget how to do it [if the old folks can click the wrong button, and they can also forget how to do it]." (Informant D, a staff Office Of Religious Affairs (KUA) Banua Lawas). The limited PEOU among senior staff creates an important role for younger staff. D, who represents the younger/Z generation and has a high PEOU, acts as an intensive assistant to ensure data accuracy. This dependence arises because of the risk of typos, which requires checking data from A to Z, which is the main responsibility of the PPN Assistant: "If we are the ones handling the marriage registration, then the Office Of Religious Affairs (KUA) registers everything from A to Z, so if there are typos or incorrect data, we young people sometimes help, but the task remains with the seniors..." (informant D, a staff Office Of Religious Affairs (KUA) Banua Lawas). This PEOU difference is a key finding. Although the leadership has successfully adopted it, the Office Of Religious Affairs (KUA) operational dependence on young staff with high PEOU to mitigate the risk of errors by staff with low PEOU threatens the effective time of staff. This escalates into a conflict between SIMKAH administrative data input tasks and Digital Pedagogy tasks.

This respondent is supported by a broader similar study on the analysis of SIMKAH Gen 4 user acceptance in the Office Of Religious Affairs (KUA) of the West Sulawesi Ministry of Religious Affairs, which found that Perceived Usefulness (PU) has a significant influence on usage intent, with 98% of admin/operator respondents stating that they could accept the application because of its benefits. However, crucially, the study also showed that Perceived Ease of Use (PEOU) did not have a significant influence on the intention to use. These results indicate that field officers tend to prioritize the benefits and functionality of SIMKAH (PU), such as administrative efficiency and data accuracy, over ease of use (PEOU) (2024). Although the system is considered difficult or effort-intensive, officers continue to use it, a condition that confirms the qualitative findings in this study regarding the trade-off between administrative time and pedagogical tasks.

3.2 Integration Dilemma: SIMKAH 4.0 and Optimization of the Role of Digital Pedagogy Penghulu

This subchapter analyzes how the digital administrative requirements of SIMKAH 4.0 affect the dual role of the Penghulu as administrator and educator (Digital Pedagogy). The findings show that there is an integration dilemma arising from varying PEOUs (as described in subchapter 3.1), which ultimately threatens the effective time for educational services. Theoretically, the implementation of SIMKAH is intended to improve the Quality of Public Services at the Office Of Religious Affairs (KUA), but in practice it has caused problems in marriage practices in the community (Anonymous, Ganaya: Journal of Social Sciences and Humanities), which are manifested in role conflicts.

On the other hand, the Positive Side of SIMKAH 4.0 as a Digital Catalyst offers significant advantages that should serve as a catalyst for efficiency and education, in line with the goal of improving public services. The online registration feature allows prospective brides and grooms (Catin) to book their wedding date and day independently from home. Furthermore, the online SIMKAH platform also provides digital marriage guidance in the form of clear written instructions and guidelines on how to register with the Office Of Religious Affairs (KUA). This impressive user interface is designed to provide transparent access to information and provide pre-marital educational resources at the beginning of the process.

Despite this high digital potential, role conflicts arise because the time that should be allocated for face-to-face guidance (pedagogical tasks) is often taken up by intensive assistance activities and SIMKAH data input. Complexity of Administrative and Genealogical Verification: In addition to basic data input issues, administrative complexity also increases due to the obligation to match the data listed online. This verification process is often difficult because genealogy data, dates of birth, and dates of marriage must be matched independently in the SIMKAH system before being verified with the physical Catin file. Determining genealogy is particularly challenging because the system requires that this data be entered online first, while legal confirmation and family genealogy can only be requested directly during the face-to-face stage when the physical file is submitted. These difficulties add to the problems in marriage practices (Anonymous, Ganaya) and slow down the workflow, even though the system is intended for efficiency (Anonymous, Global Education Scientific Journal).

Operational Dependency and Pedagogical Time Absorption: The limitations of PEOU among senior staff and the reluctance of Catin to register independently (even though booking features and guides are available) mean that registration is still handled entirely by Office Of Religious Affairs (KUA) officials. This dependency forces young a staffs informant D to prioritize completing administrative data over educational interactions with Catin. This is in line with findings in the Al-Syakhsiyyah Journal, which

show that the implementation of SIMKAH in Office Of Religious Affairs (KUA) often still struggles with operational constraints. This condition often shifts the educational role of the Penghulu to a remedial role. The focus shifts from in-depth pre-marital guidance to re-checking files to ensure they are compatible with the digital system. Low collective PEOU and technology integration without a supporting digital curriculum model make it an administrative burden. Instead of supporting the educational role, it becomes an administrative burden due to low collective PEOU. This confirms that technological innovation must be accompanied by a revision of the digital curriculum so that the educational function of the Penghulu can be optimized, in line with the importance of technology integration to improve pedagogical competence (A. J. Wibowo & Rahmat, 2021).

3.3 Strategic Digital Curriculum Model: Recommendations for Technology Integration in Education

Strategic recommendations in response to the PEOU dilemma and threats to Digital Pedagogy, with a focus on formulating a Digital Curriculum Model and Implementing Technology in Education with high Perceived Usefulness (PU) of SIMKAH 4.0, which is constrained by low Perceived Ease of Use (PEOU) among senior staff and the community, creating an integration dilemma and threatening the role of Digital Pedagogy Penghulu. These recommendations focus on three main pillars:

A. Competency-Based Digital Curriculum Model

Adaptive Upskilling Training: The curriculum model must be specifically designed to address low PEOU among senior staff, emphasizing basic error handling simulations (as per Dina's complaint). This program should focus on improving the digital competencies of Office Of Religious Affairs (KUA) staff. To ensure the success of the proposed digital curriculum and digital pedagogy model, the focus must shift from SIMKAH data input administration to improving the competencies of Office Of Religious Affairs (KUA) human resources. Needs analysis conducted in the development of e-learning for pre-marital guidance at the Office Of Religious Affairs (KUA) (2022) has confirmed the existence of competency gaps and the urgent need for digital learning platforms. These gaps must be addressed, as emphasized in the literature. (Muthoharoh, 2020), Educational transformation in the digital age requires reformulation of the curriculum and learning methods. Therefore, the Digital Curriculum Model at the Office Of Religious Affairs (KUA) must include a continuous training program for Penghulu. The main objective is to empower Penghulu to not only be proficient in using SIMKAH (improving internal PEOU), but also able to utilize digital features as educational media, so that they can effectively carry out their educational role to the community.

The Peer-to-Peer Coaching Model involves incorporating a peer-to-peer coaching model into the Office Of Religious Affairs (KUA) AFFAIRS's internal curriculum. This model utilizes young staff (digital natives) as coaches for senior staff to bridge the digital generation gap. Those with high PEOU serve as internal trainers or coaches for senior staff. This approach is more effective in bridging the digital understanding gap and directly helps mitigate the risk of input errors as internal education. Meanwhile, external PEOU education provides very simple educational media (local language video tutorials, infographics at the Office Of Religious Affairs (KUA) to increase PEOU among prospective brides and grooms, so that the burden of administrative data input can be shifted to the community.

B. The Use of Technology as an Educational Tool (Digital Pedagogy)

The importance of restructuring the role of the Penghulu from administrator to digital educator must be supported by innovative education service management. Research on Islamic Education Service Marketing Management at the Office Of Religious Affairs (KUA) (Salim et al., 2024) shows that Office Of Religious Affairs (KUA) must adopt a management strategy that focuses on the quality of educational services, including premarital counseling. This approach is relevant to the recommendations of the Digital Curriculum Model proposed in this study, in which technology (SIMKAH) is not only an administrative tool but must also be managed as the main channel for effectively communicating and distributing educational content (Digital Pedagogy). This strategy ensures that digital curriculum innovations are accessible and absorbed by the community, thereby bridging the external PEOU gap.

The public education curriculum provides very simple educational media (local language video tutorials, infographics) to increase PEOU among prospective brides and grooms (Catin). This is part of the Office Of Religious Affairs (KUA) public education curriculum to build community digital literacy and support Technology Integration. SIMKAH as Data-Driven Education encourages marriage officiants to integrate SIMKAH features and data (e.g., marriage statistics, marriage age trends) as valid and contextual teaching materials in premarital counseling. Thus, SIMKAH transforms from a mere administrative tool into a Technology Model that supports an educational role.

C. Policy Adjustments (Pedagogical Integration)

Pedagogical Task Time Allocation Policy: There needs to be internal regulations that clearly separate and protect the time allocated for Digital Pedagogical tasks (pre-marital counseling) from the demands of SIMKAH data input. Counseling time must be considered a priority, so that the educational function of the Penghulu is not displaced by administrative roles. SIMKAH as Data-Driven education encourages Penghulu to utilize the features and data generated by SIMKAH (e.g., marriage statistics, marriage age trends) as valid and contextual teaching materials in pre-marital counseling.

SIMKAH is transforming from a mere administrative tool into a catalyst that optimally supports the educational role of Penghulu.

4. CONCLUSION

This study concludes that the implementation of SIMKAH 4.0, as a core digital technology innovation in the Office Of Religious Affairs (KUA), creates an integration dilemma caused by the digital divide (low PEOU) among senior staff and external users. Although the Perceived Usefulness (PU) of SIMKAH is high in terms of administrative efficiency, the low collective PEOU forces Office of Religious Affairs (KUA) officers to shift their time back to remedial administrative tasks. Structurally, this erodes the effective time of the Penghulu to carry out their Digital Pedagogy role (pre-marital counseling), thereby hindering the intended educational transformation.

To address this dilemma, digital educational transformation in Office Of Religious Affairs (KUA) requires a systematic and strategic Digital Curriculum Model. The main recommendations are: (1) Continuous digital competency improvement (upskilling) for Penghulu through simulation-based curricula and peer-to-peer coaching; and (2) Utilizing SIMKAH as a data-driven educational tool, where system features and data are directly integrated as pre-marital guidance material. Through these educational technology adjustments, the educational role of Penghulu can be optimized, and SIMKAH 4.0 can function fully as a catalyst, not an obstacle, in providing religious education services to the community.

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Students' Perceptions of Online Video-Assisted Learning for Enhancing Japanese Language Competency

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ABSTRACT

This study examines students' perceptions of online video-assisted learning in the context of Japanese language education. This research aims to explore how learners perceive the use of online video platforms as a learning medium and how these perceptions relate to their proficiency in the Japanese language. A mixed-method design was employed, combining survey questionnaire-based quantitative data and qualitative interviews to capture students' attitudes, preferences, and perceived benefits and challenges of using online video for learning Japanese. The participants were 25 Indonesian university students enrolled in Japanese language programs who experienced video-assisted instruction as part of their learning process, both inside and outside the classroom, using the YouTube platform. The findings indicate that students generally hold positive perceptions of online video-based learning, recognizing its potential to enhance listening comprehension, vocabulary retention, and cultural understanding. YouTube is also recognized as an effective, input-rich environment when paired with explicit classroom instruction and teacher guidance for form-focused Japanese learning. Furthermore, the study highlights the pedagogical implications of integrating digital platforms in language education, promoting more autonomous and real-life Japanese learning.

Keywords: *Japanese learning, online video-assisted learning, students perceptions, YouTube.*

1. INTRODUCTION

The rapid development of information and communication technology (ICT) has significantly transformed educational practices in the digital age (Abdulrahaman et al., 2020). In contemporary language education, teachers are expected not only to deliver conventional instructional materials but also to design learning environments that promote autonomy, creativity, critical thinking, collaboration, and problem-solving skills, aligning with 21st-century competencies. These abilities are crucial for preparing learners to be confident, independent, and competitive at both national and global levels.

Among various digital learning platforms, YouTube has become one of the most widely utilized online video-sharing media. It provides diverse content ranging from personal interests and lifestyle to news, educational materials, and language use in authentic contexts. Because YouTube is easily accessible to users from different linguistic and cultural backgrounds, it serves as a valuable online learning resource, particularly for language learning (Nasution, 2019; Nofrika, 2019; Albahlal, 2019). Its multimedia features—combining sound, visuals, and animation—offer learning

experiences that are often more engaging than traditional textbooks or static classroom materials (Bastos & Ramos, 2009). The platform also offers a wide range of educational materials—from structured instructional videos to natural conversational content—that can be accessed anytime and anywhere, supporting self-directed and autonomous learning (Satriani et al., 2023; Tariq et al., 2020; Zeng, 2020). With teacher guidance, learners can select meaningful video content to enhance vocabulary, express opinions, and increase confidence in language communication.

Empirical studies have demonstrated the effectiveness of YouTube in supporting language skill development. Almurashi (2016) reported that more than 85% of students agreed that watching short video clips on YouTube improved their language competence and comprehension. Similarly, research shows significant improvements in listening and speaking proficiency when students are exposed to authentic audiovisual materials (Mutiarani & Rusiana, 2021; Alkathiri, 2019). Video-based learning can also enhance learner motivation and engagement, making the learning process more enjoyable and personally relevant (Danial, 2022; Qomariyah, Permana, & Hidayatullah, 2021). Furthermore, short video formats and live-stream interactions allow learners to access, share, and discuss learning content flexibly (Mahrus & Kiptiyah, 2024; Pratama, Arifin, & Widianingsih, 2020).

However, the effectiveness of YouTube as a language learning tool depends on several factors, including the authenticity and quality of video content, learners' critical viewing strategies, and the integration of video resources within a structured learning framework. The platform's lack of direct face-to-face interaction may also limit opportunities for communicative practice if not complemented by additional learning activities (Pratama et al., 2020).

While most existing research focuses on English language learning, studies exploring students' perceptions of video-assisted learning in Japanese language education are relatively limited, despite a significant increase in Japanese language content creators providing a wide range of instructional materials on platforms such as YouTube. Given the unique linguistic features of Japanese, such as pronunciation, intonation patterns, and socio-cultural communication norms, it is important to examine how online video resources may support the development of Japanese language skills. Therefore, this study aims to investigate students' perceptions of online video-assisted learning in enhancing Japanese language proficiency and to explore further how learners can effectively utilize YouTube online videos for Japanese learning, identifying the practices and types of content that most contribute to their success.

To achieve this goal, the study will address three primary research questions: First, what are the perceived benefits and challenges of using YouTube as an online video platform for learning Japanese? By examining learners' experiences and perceptions, the study seeks to offer a balanced perspective on the platform's strengths

and limitations, ultimately providing practical recommendations for maximizing its educational potential. Second, how do learners engage with YouTube online video content to enhance their Japanese proficiency? Understanding the strategies and practices employed by successful learners can offer insights into practical ways to utilize online video content for language development. Third, what types of YouTube online video content are most effective for learning Japanese? By identifying the specific genres and formats that provide the most significant educational benefits, this research can help teachers assist Japanese learners in selecting the most valuable sources and learning Japanese effectively through YouTube.

2. METHODOLOGY

This research aims to explore how learners perceive the use of online video platforms as learning media and how such perceptions relate to their Japanese speaking ability. A mixed-method design was employed, combining survey questionnaire-based quantitative data and qualitative interviews to capture students' attitudes, preferences, and perceived benefits and challenges of using online video for learning Japanese.

2.1. Research Design

To gather detailed insights into the participants' experiences and strategies for using YouTube online videos for learning Japanese, a survey questionnaire and in-depth interviews were conducted. Survey questionnaires were used to gather general information about learners' experiences and attitudes, as they allow for the collection of information on a wide range of topics by asking a set of questions in a relatively short amount of time (Kelley et al., 2003; Cohen et al., 2007). While interviews allowed the researchers to explore the participants' motivations, challenges, and the specific types of content they found most beneficial. The open-ended nature of the interviews provided a rich qualitative dataset, capturing the nuances of individual learning processes and preferences (Patton, 2015).

2.2. Participants of the Study

The sample for this study was selected based on the criterion that participants have prior experience with YouTube videos for Japanese learning. This is known as purposive sampling, where the sample was chosen based on specific characteristics (Cohen et al, 2007). The study involved 25 participants, all of whom were intermediate-level Japanese learners from Indonesia. These individuals were selected because they have been using YouTube online videos as a supplemental tool for learning Japanese for over two years, inside and outside the classroom. Their experience with the platform

has given them a level of familiarity and engagement that makes them ideal candidates for exploring the effectiveness of YouTube in Japanese learning.

3.3. Instruments

Survey questionnaires with a five-point Likert scale, ranging from "strongly agree" to "strongly disagree," were used to gather general information about learners' experiences and attitudes. This type of scale is commonly used in research to measure attitudes and perceptions. By using a Likert scale, we can assign numerical values to the responses and analyse the data quantitatively, which will provide more accurate and reliable results. Moreover, semi-structured interviews with open-ended questions enabled the researchers to explore the participants' motivations, challenges, and the specific types of content they found most beneficial for their success in learning Japanese.

2.4. Data Analysis Techniques

The data collected from the survey questionnaires were analyzed using descriptive statistics. Each item on the scale was scored as follows: 5 points for Strongly Agree (SA), 4 points for Agree (A), 3 points for Neutral (N), 2 points for Disagree (D), and 1 point for Strongly Disagree (SD). The results of the semi-structured interviews were analyzed using thematic analysis. This method was chosen for its effectiveness in identifying, analyzing, and reporting patterns (themes) within qualitative data (Braun & Clarke, 2006). Thematic analysis allowed the researchers to systematically examine the participants' responses, leading to the identification of key themes related to the use of YouTube videos in Japanese learning. These themes provided a structured way to understand the varied experiences of the participants and to draw broader conclusions about the effectiveness of different types of YouTube content in enhancing language proficiency (Daeli & Santosa, 2025).

3. RESULT AND DISCUSSION

Results are the main part of scientific articles, containing: final results without data analysis process, hypothesis testing results. Results can be presented with tables or graphs, to clarify the results verbally. Discussion is the most important part of the entire contents of scientific articles. The objectives of the discussion are: answering research problems, interpreting findings, integrating findings from research into existing sets of knowledge and composing new theories or modifying existing theories.Based on the findings of the questionnaire, the responses of the students to each item are shown in Table 1 below.

Tabel 1. Table of Participants Perceptions Towards YouTube Online Videos for Japanese Learning

No	Statement	Mean (SD)	SD
1	YouTube videos help me learn new Japanese vocabulary that I have not learned in the classroom.	4.60	.500
2	When I struggle to concentrate on my studies, YouTube videos help me stay attentive with the interesting and varied content.	4.32	.476
3	YouTube videos make learning Japanese an exciting experience.	4.20	.645
4	The Japanese language content of the YouTube videos is easy to comprehend.	3.68	.690
5	Do not think YouTube improves my vocabulary retention.	1.68	.476
6	YouTube provides relevant materials to prepare assignments.	3.48	.585
7	YouTube offers relevant materials to help you learn the Japanese language.	4.48	.509
8	I found it challenging to select the most suitable YouTube video materials for learning Japanese.	2.20	.816
9	Writing down the significant points in a diary while watching videos on YouTube helps me acquire Japanese.	4.40	.500
10	Watching YouTube videos helps me develop my speaking skills.	4.24	.597
11	The YouTube videos enhance my listening comprehension.	4.64	.489
12	Use of YouTube enhances my grammatical competence.	3.24	.879
13	YouTube does not improve my basic Japanese competencies (listening, speaking, and reading comprehension).	2.04	.611
14	I am not interested in using YouTube Videos for learning Japanese.	1.36	.489
15	YouTube videos help me to learn real-life Japanese context, such as manners, culture, norms, etc.	4.48	.509

n: 25

The findings of the study were supported by the semi-structured interview results, as it shown in table 2 below.

Tabel 2. Table of Participants Positive Response Towards YouTube Online Videos for Japanese Learning

Participants	Participants Response	Category
S1, S7	"My listening and speaking ability have been increased through listening to Japanese-speaking channels, podcasts, vlogs, animated movies, and Japanese songs. I have started confidently speaking in Japanese after getting input from the YouTube channel."	Types of Effective YouTube Content for Language Learning: Vlogs and real-life context videos
S15, S23	"I always take notes and remember a few Japanese words and phrases from YouTube channels, which I use in my daily conversations."	Types of Effective YouTube Content for Language Learning: Conversational videos
S12, S18	"When a teacher asks me to complete a Japanese teaching project assignment, I search for example models on YouTube. The YouTubers explain the topic in simple language, making it easier for me to comprehend."	Types of Effective YouTube Content for Language Learning: Structured lessons and tutorials, Frequency of Using YouTube
S22, S24	"Japanese tutorials provide structured lessons, clear explanations, and examples to illustrate grammar rules, vocabulary usage, and pronunciation."	Types of Effective YouTube Content for Language Learning: Structured lessons and tutorials
S2	"The YouTube videos on Japanese grammar are interesting and help me to understand easily."	Types of Effective YouTube Content for Language Learning: Structured lessons and tutorials
S6, S13	"I use YouTube to learn Japanese almost every day, watching one or two videos daily to improve my skills and expand my knowledge of Japanese culture."	Frequency of Using YouTube
S5, S16	"Learning Japanese through YouTube was very convenient because I could learn at any time and from anywhere I wanted. Moreover, I can select the materials I want to learn at the time"	YouTube's flexibility

Tabel 3. Table of Participants Negative Response Towards YouTube Online Videos for Japanese Learning

Participants	Participants Response	Category
S6, S10, S13	"YouTube has so many videos, but it is hard to tell which ones are actually good for learning. So, I need assistance from the lecturer to help me select the appropriate videos for my Japanese learning."	YouTube's flexibility

Participants	Participants Response	Category
S19, S12	"I watched Japanese grammar lessons on YouTube, but I found it difficult to learn since I struggled to understand the grammatical items explained by the mentors. Especially to understand the meaning of similar Japanese grammar or expressions in my mother tongue."	Types of Effective YouTube Content for Language Learning: Structured lessons and tutorials
S1	"After watching Japanese lessons or tutorials on YouTube, many questions arise in my mind. However, I cannot ask the speaker these questions. Therefore, my queries remain unanswered. It does not seem that helpful if we watch the Japanese lessons channel"	Types of Effective YouTube Content for Language Learning: Structured lessons and tutorials

n: 25

The results indicate that students generally hold highly positive perceptions of YouTube as a supplementary learning tool for learning Japanese. The strongest perceived benefits are seen in the development of listening comprehension (see statement 11, Mean of 4.64), acquisition of new vocabulary (see statement 1, Mean of 4.60), and understanding of real-life cultural and pragmatic contexts (see statement 15, Mean of 4.48).

These findings align with the results of the study carried out by Chien, Huang, and Huang (2020) and Al Harbi (2019), which indicated visible improvement in Taiwanese learners' and Saudi learners' listening comprehension skills after receiving input from YouTube videos. In terms of vocabulary acquisition, these findings are similar to those of a study conducted by Kabooha and Elyas (2018) and Hia (2021), which found that learners were highly motivated to learn vocabulary by watching educational YouTube videos. These occurred as learners repeatedly watched and listened to audio and videos; they became curious about the new words whenever they encountered them, and learned spontaneously (Tahmina, 2023). The findings also highlight YouTube's motivational benefits, particularly its role in sustaining learner engagement and attention. These results parallel earlier work by Kelsen (2009) and Jones and Cuthrell (2011), who found that learners respond positively to digital platforms due to their accessibility and variety of media content. Positive findings can also be seen in learners' comprehension of real-life cultural and pragmatic contexts.

Students consistently agreed that YouTube exposes them to authentic Japanese language use beyond what is provided in classroom settings, particularly phrases used in daily communication, colloquial expressions, and context-based vocabulary, helping learners apply Japanese in real-life situation. Such content helps learners improve conversational skills and build confidence. These findings is supported by research of Toleuzhan et al., (2022), who implied that exposure to natural spoken language in various contexts enhances learners' listening comprehension and spoken language

abilities. The strong agreement on these aspects suggests that exposure to authentic audiovisual input plays a central role in supporting language learning. These results align with previous studies in English as a foreign language contexts, where learners who regularly engaged with YouTube content showed improvement in listening comprehension (Chien, Huang, & Huang, 2020; Al Harbi, 2019). Similarly, the findings are consistent with Kabooha and Elyas (2018) and Hia (2021), who reported that YouTube effectively enhances learners' vocabulary development by stimulating curiosity and enabling spontaneous acquisition through repeated exposure. As noted by Tahmina (2023), repeated listening and viewing of authentic materials encourage learners to naturally internalize new words. This is also supported by Toleuzhan et al. (2022), who emphasized the value of natural spoken input in improving learners' communicative abilities and confidence.

The availability of diverse and engaging content also sustains attention and motivation, suggesting that YouTube supports emotional engagement in the learning process (see statements 2 and 3, with a Mean of 4.32 and 4.20). This demonstrates YouTube's importance in consistent language exposure. This aligns with the findings of previous studies, such as Kelsen (2009) and Jones and Cuthrell (2011), which emphasized that digital platforms like YouTube are effective in promoting regular language practice due to their accessibility and the wide range of available content.

The frequency of using YouTube as a tool for learning Japanese shows significant variability among learners, reflecting diverse learning habits and schedules. This demonstrates YouTube's importance in consistent language exposure. This aligns with the findings of previous studies, such as Kelsen (2009) & Jones and Cuthrell (2011), which emphasized that digital platforms like YouTube are effective in promoting regular language practice due to their accessibility and the wide range of available content, directly correlates with improved language proficiency, suggesting that daily exposure can significantly enhance learning outcomes.

In terms of YouTube's flexibility, nature is another key factor in its popularity among language learners. The platform allows users to learn at their own pace, revisit content as needed, and tailor their learning experiences to fit their lifestyles. This finding is supported by research from Watkins and Wilkins (2011) & Ong Long et al. (2023), who noted that the flexibility of online learning platforms empowers learners to take control of their learning process, resulting in more personalized and engaging learning experiences.

However, despite these strengths, the findings reveal limitations in grammar acquisition, suggesting that while YouTube promotes implicit learning, it does not independently facilitate systematic understanding of grammatical structures. Moreover, although many students felt confident navigating YouTube, some faced challenges in selecting appropriate materials, indicating variation in digital literacy and the need for

teacher guidance. This concern is echoed in earlier research, for instance, Yaradılmış et al. (2020) noted that the most viewed YouTube videos were often found to have lower quality scores, suggesting that popularity does not equate to the reliability of the content. The issue of inconsistent motivation and self-discipline is a significant challenge in autonomous learning. Previous research by Holec in Daeli & Sentosa (2025) and Ushioda (2008) has emphasized that successful autonomous learning requires a high degree of self-regulation and intrinsic motivation.

Several recommendations can be made based on the study's findings. Japanese language teachers can start using YouTube as a language-learning tool as it plays a vital role in learning (Almurashi, 2016). Gradually, learners will come to rely on this platform as a spontaneous and essential task. A variation in the choice of YouTube videos is necessary; otherwise, their use might not motivate language learners. Usually, learners get input in the language classes. When a language teacher suggests watching a Japanese movie to learn vocabulary, it is enjoyable for them. They learn wholeheartedly and in a stress-free mood (Heriyanto, 2018).

4. CONCLUSION

The findings indicate that students regard YouTube as a powerful supplementary resource for advancing Japanese proficiency, particularly for listening comprehension, vocabulary growth, and pragmatic/cultural understanding, because it provides abundant authentic audiovisual input that textbooks often lack. Pedagogically, this suggests teachers should deliberately integrate well-curated YouTube materials into course designs to exploit their strengths (authenticity, repetition, multimodality) while scaffolding learners' use of the platform through digital-literacy training and guided activities (note-taking, shadowing, tasks that require product creation). The platform's motivational affordances (sustained attention, variety, and flexible pacing) make it particularly useful for promoting regular exposure and autonomous practice. However, reliance on YouTube without teacher mediation risks uneven quality, shallow grammar learning, and selection difficulties among learners.

In conclusion, YouTube is most effective as a complementary, input-rich environment paired with explicit classroom instruction for form-focused learning and teacher guidance. therefore, course designers should combine input activities (vlogs, podcasts, clips) with targeted grammar explanations, evaluation rubrics, and digital literacy modules to maximize gains.

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Empowering Parents through Andragogy: A Systematic Review on Parental Involvement in Children's Mathematics Learning

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ABSTRACT

This study examined parental involvement in children's mathematics learning through an andragogical approach as the foundation for developing a lifelong learning–based parental empowerment model. The study addressed the problem that many parents, although willing to assist their children, often lack effective strategies to support mathematics learning at home. To provide a systematic understanding of this issue, a Systematic Literature Review (SLR) was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework. The review process involved identifying, screening, and analyzing relevant studies retrieved from academic databases such as Google Scholar, ERIC, Scopus, ScienceDirect, and SpringerLink. Out of 200 initially identified publications, 30 studies met the inclusion criteria and were analyzed thematically. The results indicated that applying andragogical principles effectively improved parents' awareness, motivation, and confidence as adult learners in guiding their children's mathematics learning. Furthermore, integrating Indonesian Realistic Mathematics Education (PMRI) and deep learning approaches promoted contextual, reflective, and meaningful learning experiences. The synthesis concluded that the integration of andragogy, parental involvement, and realistic learning approaches provided a solid conceptual basis for developing a lifelong learning–oriented parental empowerment model that strengthens collaboration between schools and families.

Keywords: *andragogy, mathematics learning, parental involvement, PMRI*

1. INTRODUCTION

Mathematics learning at the elementary school level is a complex process, as it is influenced not only by students' internal abilities but also by external factors such as parental involvement and the home learning environment. Various studies have shown that parents' attitudes, beliefs, and self-confidence toward mathematics significantly affect their children's motivation and academic achievement (Maloney et al., 2015; Soni & Kumari, 2015; Liu & Leung, 2021). When parents experience anxiety or doubt about mathematics, such attitudes are often transmitted to their children, creating a less supportive learning atmosphere at home.

Conversely, positive and well-directed parental involvement has been shown to enhance children's interest, confidence, and achievement in mathematics. Parents play an essential role as facilitators, motivators, and learning partners who provide both emotional support and academic guidance (Purwanto & Kurniasih, 2018; Cacabilos & Vargas, 2022; Wang & Sheikh-Khalil, 2022). However, most parental involvement

practices to date have focused mainly on motivational support and the provision of learning resources, rather than on helping parents themselves learn and develop conceptual understanding of mathematics.

This situation reveals a critical gap: many parents are involved, yet not fully empowered as adult learners who can effectively support their children's learning. Without appropriate knowledge and learning strategies, parental involvement risks reinforcing misconceptions or increasing learning anxiety for both the child and the parent. Therefore, parental engagement needs to be complemented with approaches that empower parents cognitively and reflectively, in line with their characteristics as adult learners.

The andragogical approach, which emphasizes experience-based, problem-oriented, and self-directed learning, is highly relevant in this context. According to the principles of andragogy proposed by Knowles (Henschke, 2016; Fitzsimons, 2005; Merriam & Baumgartner, 2020), adults learn most effectively when the learning process is directly connected to real-life experiences, values prior knowledge, and provides autonomy in how new information is understood. In the context of family education, applying these principles can transform parents' roles from passive companions to reflective facilitators who actively guide their children's mathematics learning.

Although the potential of andragogical principles in empowering parents has been widely discussed, systematic studies specifically evaluating their implementation in mathematics learning remain limited. Most existing research focuses on a single aspect either parental involvement or adult learning without integrating both perspectives into a unified analytical framework (Rahmawati & Hiryanto, 2023). Therefore, a comprehensive review is needed to examine how andragogical principles have been applied to support parents' roles in children's mathematics learning at the elementary school level.

This study aims to address this gap through a Systematic Literature Review (SLR) based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework. A total of 30 scholarly articles published between 2012 and 2025 were thematically analyzed to identify trends, best practices, and challenges in applying andragogical principles within the context of parental involvement. Through this synthesis, the study seeks to provide a comprehensive understanding of how experience-based learning, contextual relevance, and active participation can empower parents as adult learners and reflective facilitators in supporting their children's mathematics learning.

2. METHODOLOGY

The method employed in this study is the Systematic Literature Review (SLR). This method was chosen because it provides a systematic, transparent, and replicable approach for identifying, selecting, analyzing, and synthesizing literature relevant to the research topic (Petticrew & Roberts, 2006; Tranfield, Denyer, & Smart, 2003). In this context, the SLR was used to examine how parental involvement in children's mathematics learning, particularly at the elementary school level, has been implemented, and to what extent andragogical principles have been applied or can be integrated within this process.

This study not only aims to understand how parents are involved affectively or motivationally, but also seeks to explore the extent to which parents comprehend mathematical concepts and employ effective ways to teach them to their children from an adult learning perspective. The SLR procedure followed six main stages as outlined by Triandini et al. (2019) and adhered to the PRISMA reporting standards (Moher et al., 2009; PRISMA 2020) to ensure transparency and accountability. These six stages include:

- Formulating research questions;
- Conducting a systematic literature search;
- Establishing inclusion and exclusion criteria;
- Assessing the quality of the selected studies;
- Extracting data; and
- Conducting thematic analysis and synthesis.

The literature search was conducted across major academic databases Google Scholar, ERIC, Scopus, ScienceDirect, and SpringerLink using combinations of English and Indonesian keywords (e.g., "parental involvement in mathematics learning," "andragogy in education," "adult learning," "*Keterlibatan orang tua*"). The review focused on articles published between 2012 and 2025 to capture both historical developments and recent findings. The initial search (May 2025) yielded 200 potential articles, which were then screened through several stages: identification, abstract screening, full-text review, and quality assessment using evaluation instruments suited to the respective methodological approaches (Higgins et al., 2019).

The literature search was conducted using a structured keyword strategy to ensure comprehensive and systematic retrieval of relevant studies. Keywords were developed based on the core concepts of the study, namely parental involvement, andragogy, adult learning, and mathematics learning. To ensure transparency and replicability of the literature search process, the keyword search strategy and the use of Boolean operators are explained in the following subsection.

The search terms were applied using Boolean operators (AND, OR) to broaden and refine the search results across databases. The main search strings included:

1. (“parental involvement” OR “family involvement” OR “parent participation”) AND (“mathematics learning” OR “mathematics education” OR “math achievement”)
2. (“andragogy” OR “adult learning” OR “adult education”) AND (“parent education” OR “family education”)
3. (“parental involvement” AND “andragogy”) AND (“mathematics learning” OR “realistic mathematics education” OR “PMRI”)

To capture studies published in the Indonesian context, equivalent Indonesian keywords were also used, such as: “*keterlibatan orang tua*” AND “*pembelajaran matematika*”, “*andragogi*” AND “*pendidikan keluarga*”

These search strings were applied consistently across all databases (Google Scholar, ERIC, Scopus, ScienceDirect, and SpringerLink). Filters were used to limit results to peer-reviewed journal articles, full-text availability, and publications between 2012 and 2025. This strategy ensured that the selected studies were both relevant and methodologically robust, in accordance with PRISMA guidelines.

The inclusion criteria for this study were: (a) peer-reviewed empirical articles discussing parental involvement in mathematics learning; (b)studies addressing or applying andragogical principles; and (c) research conducted within the context of primary or secondary education. The exclusion criteria included: non-empirical articles (e.g., opinion papers or reports without data), studies outside the context of mathematics education, and publications without full-text access. All included articles were labeled by year and title, and analyzed both manually and thematically to identify the research focus, methodology, key findings, evidence of andragogical application, and forms of parental involvement. The extracted data were organized and visualized (in tables and diagrams) to reveal emerging trends, best practices, and research gaps, forming the basis for recommendations on andragogy-based parental empowerment programs.

3. RESULT AND DISCUSSION

3.1. Results of Analysis

This study was conducted using a Systematic Literature Review (SLR) that followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method. The analysis process was carried out through four main stages: identification, screening, eligibility assessment, and inclusion of the final results.

At the initial stage, the researcher conducted a literature search through several major academic databases, namely Google Scholar, ERIC, Scopus, ScienceDirect, and SpringerLink. The search used a combination of English and Indonesian keywords such as “parental involvement in mathematics learning,” “andragogy,” “adult learning in parenting,” and their Indonesian equivalents, “keterlibatan orang tua dalam pembelajaran matematika” and “pembelajaran orang dewasa dalam pendidikan

keluarga." The initial search yielded 200 scientific articles that were potentially relevant to the research topic. A preliminary verification process was then carried out to ensure data accuracy. From this process, it was found that 32 articles were duplicates, 80 were irrelevant based on the keywords, and 25 were removed because they lacked full text or abstracts. Consequently, 58 articles proceeded to the screening stage.

During the screening stage, each article was examined based on its title and abstract, considering its relevance to the main focus of the study, namely the application of andragogical principles in parental involvement in children's mathematics learning. From this screening, 8 articles were eliminated due to irrelevance to the research context, leaving 50 articles for further examination (reports sought for retrieval).

However, of these, 5 articles could not be accessed in full text, resulting in 45 articles advancing to the eligibility assessment stage. At this stage, all articles were read thoroughly and evaluated according to the established inclusion and exclusion criteria. The evaluation excluded 15 articles for not meeting the research requirements: 9 did not focus on the context of children's mathematics learning, and 6 did not discuss andragogical principles or adult learning theories. Finally, 30 articles met all the criteria and were included in the systematic analysis. As each article represented a unique study, the number of "studies included in the review" and "reports of included studies" were both 30.

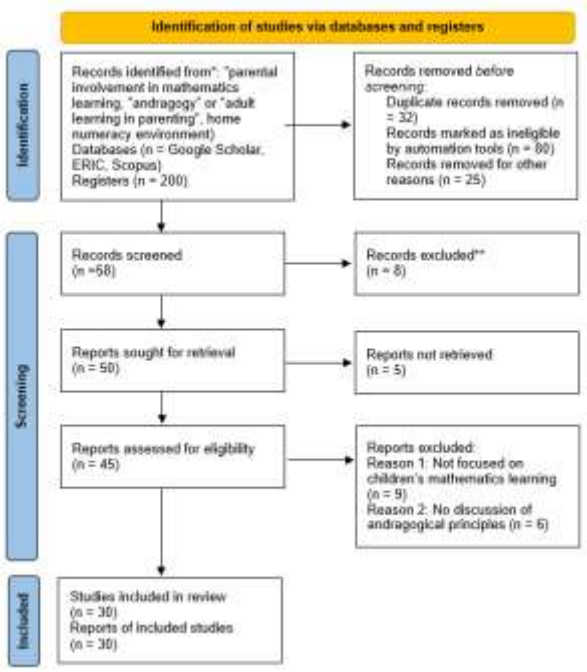

Figure 1. Metode PRISMA

3.2 Determination of Inclusion Results

The determination of inclusion and exclusion criteria was carried out carefully to ensure that the articles analyzed were truly relevant to the research objectives and

possessed adequate academic credibility. The inclusion criteria comprised several key considerations. First, the selected articles were national or international scholarly publications released between 2012 and 2025. These articles were required to specifically discuss parental involvement in children's mathematics learning or the application of andragogical principles or adult learning, in accordance with the theoretical framework of this study. Another criterion was that the articles had to be published in peer-reviewed journals and contain verifiable empirical data, ensuring that the analysis was grounded in a solid scientific basis.

Meanwhile, the exclusion criteria were established to filter out articles that did not meet academic and methodological standards. Articles were excluded from the analysis if they were non-academic works, such as opinion pieces or activity reports lacking clear research methodology. Likewise, studies that discussed parenting topics in general without specific reference to mathematics learning were not included in the review. In addition, duplicate articles or those without full-text access were also excluded to maintain the validity and consistency of the literature review findings.

3.3 Search Results and Article Distribution

The literature search conducted across five academic databases (Google Scholar, ERIC, Scopus, ScienceDirect, and SpringerLink) yielded 200 potential articles, which, after undergoing the PRISMA-guided screening process, resulted in 30 articles that met the inclusion criteria for in-depth analysis.mFrom the 30 reviewed articles, a significant increase in publication trends was identified beginning in 2020, particularly on topics related to the application of andragogical principles, parental involvement in children's learning, and Realistic Mathematics Education (RME/PMRI) combined with deep learning approaches.This increase aligns with the shift in educational paradigms in the post-pandemic era, during which the roles of families, local cultural contexts, and adult learning principles have become increasingly recognized as essential components in children's education.

Figure 2. Distribution of Articles by Year of Publication (2012–2025)

The data in the table above indicate that more than half of the articles (57%) were published between 2020 and 2023, reflecting a growing interest in family-based,

contextual, and reflective learning approaches. This trend suggests that researchers have increasingly focused on the connections between parental roles, andragogical principles, and meaningful mathematics learning strategies within both formal and non-formal educational contexts.

3.4 Distribution by Research Method

Of the 30 articles analyzed, most employed qualitative approaches, including designs such as literature reviews, grounded theory, phenomenology, and design-based research. These approaches were widely used to explore learning experiences, patterns of parental involvement, and the implementation of andragogical principles in real-world contexts.

Several other articles utilized quantitative approaches, such as descriptive correlational studies and structural equation modeling (SEM), which focused on examining the relationships among learning motivation, parental involvement, and children's learning outcomes. Meanwhile, a smaller number of studies adopted mixed-methods designs to obtain a more comprehensive understanding of the phenomena under investigation.

Figure 3. Distribution of Articles Based on Research Methods

Based on the distribution above, qualitative research continues to dominate, reflecting the nature of the topic, which emphasizes the exploration of meaning, learning experiences, and reflective processes from the perspectives of adults and families. However, quantitative studies have begun to increase in recent years, particularly to verify the empirical impact of applying andragogical principles and parental involvement on children's mathematics learning outcomes.

3.5 Distribution by Research Themes

The thematic analysis of the thirty articles that passed the selection process revealed four major themes that became the primary focus within the reviewed literature. These themes reflect the integration of andragogical approaches, parental involvement, and realistic and deep mathematics learning.

Table 1. Distribution of Articles by Main Themes

Research Theme	Number of Articles	Description of Focus
Integration of PMRI and Deep Learning in Mathematics Education	9 articles	Examines the implementation of the Realistic Mathematics Education approach (RME/PMRI) combined with deep learning strategies to enhance students' conceptual understanding.
Application of Andragogical Principles in Adult Learning and Family Education	8 articles	Explains how andragogical principles (Knowles) are applied in training programs for parents and teachers as adult learners.
Parental Involvement and Emotional Support in Children's Mathematics Learning	7 articles	Describes the role of parents as facilitators, motivators, and guides in supporting children's learning at home.
Challenges and Strategies for Parent Empowerment Through Reflective Learning	6 articles	Identifies the challenges and strategies for empowering parents through experience-based training and andragogical reflection.

This thematic distribution shows that most studies emphasize integrative efforts between realistic mathematics education approaches and adult learning. These findings indicate that the application of andragogical principles is not only relevant to formal adult education, but can also be implemented within the family education context, particularly in supporting children's mathematics learning through contextual and meaningful approaches.

3.6 Synthesis of Findings

From the overall analysis of the thirty articles selected through the Systematic Literature Review process, a comprehensive picture emerges regarding the relationship between andragogical principles, parental involvement, and realistic-based mathematics learning. In general, the findings indicate that andragogy is effective in enhancing parents' and teachers' learning awareness as adult learners. Principles such as contextual relevance, appreciation of prior experiences, and learner autonomy enable parents to be better prepared to take an active role in supporting their children's academic development.

In addition, parental involvement in mathematics learning has been shown to positively influence children's motivation and learning outcomes. This involvement is reflected in home learning support, active communication with teachers, and emotional encouragement that fosters children's confidence in understanding abstract mathematical concepts. Several studies even demonstrate that andragogy-based training for parents can improve their ability to explain mathematical concepts in contextual and engaging ways.

From the perspective of instructional approaches, studies examining PMRI (Indonesian Realistic Mathematics Education) and deep learning show that both approaches effectively promote meaningful learning that is relevant to real-life situations. Through activities grounded in everyday contexts and local culture, students not only grasp mathematical concepts procedurally but also connect them to daily experiences. This approach simultaneously strengthens parents' roles as facilitators in creating reflective and context-rich learning environments at home.

Furthermore, the findings highlight that andragogy-based empowerment programs hold substantial potential as effective strategies for strengthening collaboration between schools and families. Such programs enable parents to gain new insights into how to support their children's learning processes while also fostering a sense of confidence and ownership in contributing to their children's educational success.

3.7 Discussion

The findings of this systematic literature review indicate that parental involvement in children's mathematics learning cannot be separated from andragogical principles, which position parents as adult learners. As adult learners, parents possess life experiences, intrinsic motivation, and diverse learning needs. Therefore, effective support strategies must be grounded in an understanding of these characteristics (Knowles, 1980).

The results from the 30 reviewed articles show that the application of andragogical principles in family education has a significant impact on increasing parents' learning awareness and their active role in supporting their children's education. Parents do not merely function as providers of learning resources; they also serve as facilitators, motivators, and learning partners. This aligns with the findings of Purwanto & Kurniasih (2018) and Cacabilos & Vargas (2022), which emphasize that parents' emotional and cognitive involvement is positively correlated with children's mathematics achievement.

Furthermore, the thematic analysis reveals a strong relationship between andragogy, parental involvement, and realistic learning approaches (PMRI). In this context, adult learning principles such as relevance, experience, active participation, and reflection are proven effective when combined with Realistic Mathematics Education (RME), which is grounded in real-life contexts. The PMRI approach helps parents understand mathematical concepts contextually, enabling them to explain material to children in ways that are simple, meaningful, and closely connected to daily experiences.

In addition, the emergence of deep learning as an approach emphasizing conceptual understanding and reflective thinking contributes to the improvement of

learning quality. When parents understand the principles of deep learning, they can guide their children to move beyond memorizing formulas toward understanding the reasoning behind mathematical concepts. This is consistent with the findings of Rodrigues (2012) and Mujib et al. (2019), who found that experience-based and reflective learning enhances students' critical thinking skills and confidence in learning mathematics.

Nevertheless, the review also identifies several challenges in applying andragogical principles within family education contexts. Many parents face limitations such as lack of time, insufficient understanding of mathematics content, and low confidence in assisting their children. Several studies, including those by Hadiyanti & Dewi (2020) and Bahar et al. (2021), show that educational background and socioeconomic conditions also influence the extent to which parents can play an effective role. Therefore, educational institutions both formal and non-formal need to provide andragogy-based training to help parents develop learning support strategies that align with their children's needs.

Beyond offering direct benefits to children's learning, the application of andragogical principles also has broader implications for community empowerment and family literacy development. By recognizing themselves as lifelong learners, parents not only contribute to their children's academic growth but also help cultivate a learning culture within the family environment. This aligns with the spirit of non-formal education and lifelong learning, which positions the family as a primary foundation for human capacity development.

Conceptually, the integration of andragogy, parental involvement, and realistic learning approaches in mathematics can serve as a foundation for developing an andragogy-based parent empowerment model. This model emphasizes collaboration between schools, families, and communities in creating a participatory, contextual, and meaningful learning ecosystem. In the long term, such a model is expected to strengthen parents' abilities as reflective learning facilitators, enabling children's learning processes to become more independent and sustainable.

4. CONCLUSION

This study concludes that parental involvement in children's mathematics learning is closely linked to the application of andragogical principles as the foundation of adult learning. Through a PRISMA-based Systematic Literature Review (SLR), thirty articles were identified that collectively provide a comprehensive understanding of how andragogy, parental involvement, and realistic learning approaches (PMRI) can be integrated to build a reflective, independent, and sustainable family education ecosystem. The main findings show that implementing andragogical principles such as valuing prior experience, ensuring contextual relevance, and encouraging active

participation has a positive impact on enhancing parents' awareness and roles as adult learners.

Parental involvement grounded in andragogical approaches not only improves children's motivation and mathematics learning outcomes but also strengthens the relationship between home and school through constructive communication and collaboration. In addition, the integration of PMRI and deep learning approaches in the learning process has been shown to create more meaningful and contextually relevant mathematics learning experiences for children. Within this context, parents act as facilitators who not only help children understand academic content but also foster curiosity, critical thinking, and reflective abilities.

Furthermore, the findings demonstrate that andragogy-based empowerment programs can serve as an effective strategy for strengthening the capacity of families as learning agents. By understanding the characteristics and learning needs of adults, such programs can support parents in developing contextual pedagogical skills aligned with their children's developmental needs, particularly in mathematics learning. Thus, it can be concluded that the integration of andragogical principles, parental involvement, and realistic learning approaches forms a strong conceptual framework for developing a lifelong learning–oriented parent empowerment model. This model is expected to serve as a foundation for designing more effective family education programs that are adaptive to contemporary changes and oriented toward meaningful learning for both children and parents.

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Empowering Girls Through Science and Coding: Using Computational Thinking to Address Social Issues

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ABSTRACT

This research aims to close the gap between scientific facts and social beliefs when the human reproductive system is taught, with a focus on the issue of stigmatizing menstruation. The point is to introduce computational thinking into science education as a means of producing not only understandable but also empathetic and socially aware learning. Using a qualitative descriptive approach, the ninth graders from a rural middle school were involved in learning through the 5E Learning Cycle model and computational thinking steps. Girls participated in a survey on menstrual experiences, while boys researched the stigma and misconceptions. Data were analyzed and used to develop educational websites with the assistance of Canva Code and ChatGPT. The output reflected the increase of both cognitive and affective levels, as girls became more self-assured and conscious of themselves, whereas boys, conversely, gained empathy and respect for menstruation. Research findings highlight that computational thinking has the potential not only to foster a logical understanding but also a human one, which in turn makes science learning a powerful tool for societal change. Authors propose this method to be applied in various scientific and social contexts for subsequent research.

Keywords: *computational thinking, empowering girls, menstrual cycle prediction, reproductive system, social issue.*

1. INTRODUCTION

This research reveals the differences between scientific knowledge and societal reality that exist in the case of the human reproductive system learning. More specifically, it is aimed at getting rid of the stigmatization of menstruation. The project wants to use science education as an occasion to reach out to the learners by integrating computational thinking, thus making the learning process empathetic and socially aware. Using a qualitative descriptive approach, 9th-grade students from a rural junior high school learned through the 5E Learning Cycle model combined with computational thinking steps. Girls were surveyed on their personal experiences with menstruation while boys talked about stigma and misconceptions. After analyzing the data, websites were created for educational purposes with the help of Canva Code and ChatGPT.

Despite the differences in culture and time, the fact that menstruation is among the most misunderstood and stigmatized aspects of human biology has remained unchanged. Even though it is a natural physiological process, it is still a phenomenon that is often met with silence and shame, especially in conservative or rural societies (Baruah, 2025; Chrisler, 2013; Kaundal, 2014). A lot of adolescent girls experience their

first menstruation without receiving any correct information, guidance, or emotional support, which results in them feeling anxious, embarrassed, and having bad menstrual hygiene practices. These problems go beyond the scope of the individual's challenge - they are the characteristics of the system and the education sector. When schools do not openly talk about menstruation, they are at the same time promoting it as a hidden curriculum which not only maintains gender inequality but also misinformation (Okafor-Terver, 2025).

Scholarly works reveal that the denial of menstrual hygiene is mainly due to maintaining social taboos, compliance with religious rules, and the lack of informative education about reproductive health (Peranovic, 2025). Such stigma at times is a factor that cuts girls off from school life and thus, it is an ultimate cause of absenteeism, loss of confidence as well as unequal experiences of learning (Rath et al., 2020). Also, males to a great extent are unaware of menstruation during childhood and they see it as something that is secretive and not suitable to be talked about. The lack of knowledge among boys might be the reason why they harass girls with whom they make fun of, and whom they scorn further.

Learning, therefore, is not only an imperative but also an urgent matter. According to Baruah (2025), education is “a transformative instrument capable of reshaping beliefs, dismantling myths, and promoting empathy.” Menstrual issues being taught through scientific subjects can make students realize the truth about menstruation and this would alleviate misconceptions or taboos especially in the case of boys. The matter, however, calls a teaching method that does not simply consist of reproduction organs' names or that of functions of the body. Learning should be the way by which students question the norms of the society, doubt scientific facts, and use their knowledge in their daily life.

Introducing menstruation in a manner that is inclusive has two advantages: firstly, it makes female biology a matter of common knowledge, and secondly, through it boys get the understanding of girls. When boys are a part of talks on menstruation, they stop seeing it as a topic that makes them embarrassed and treat it as a part of a bigger knowledge of human health. Various research have been conducted to prove that such all-inclusive educational methods result in less stigma and in turn more positive social attitudes towards young people (Johnston-Robledo et al., 2007; Peranovic, 2025). Thus, menstrual education should not be just limited to health classes—it should be a moral and societal lesson delivered through science.

Therefore, educational intervention in this case, is not only necessary but also of the highest urgency. Baruah (2025) expresses it, education is "a transformational tool capable of changing one's views, tearing down falsehoods, and, above all, spreading understanding." Incorporating menstrual education in science teaching would enable students (both boys and girls) to perceive menstruation as a natural biological process

rather than a moral or socio-cultural taboo. However, this undoubtedly involves a teaching method that does not only touch on the reproductive organs or even simply naming the bodily functions. On the contrary, education should enable students to challenge social norms, to question scientifically proven facts, and to use their knowledge in the real world.

In order to deal with menstruation in a substantial manner, educators require teaching materials which would attract students not only intellectually but also socially and emotionally. The instructional intervention was designed using the 5E Learning Cycle (Engagement, Exploration, Explanation, Elaboration, and Evaluation) as the pedagogical structure, while Computational Thinking served as the cognitive framework guiding data analysis and digital product development.

The 5E model has been widely referred to as an efficient teaching tool that helps students understand concepts and become scientifically literate. Beffa-Negrini et al. (2007) claimed that the 5E method significantly raises teachers' and students' capacity to evaluate information with a critical eye and to use inquiry-based reasoning in different contexts. Baptist (2006) also noted that students who were taught through the 5E method remembered the concepts for a longer time and were able to communicate and reason better. The 5E model, with its iterative and introspective nature, is very helpful in menstrual education as it turns the transformation of the topic from something that is emotionally charged into an authentic, respectful conversation and understanding.

Besides constructivist ways, Computational Thinking (CT) is a framework that has become a benchmark for students as it teaches them to solve problems in a logical and innovative way. Wing (2006) regards CT as "the thought processes involved in formulating problems and their solutions in a way that a computer—human or machine—can effectively carry out." The first one is decomposition, which means breaking down complex problems into smaller parts, pattern recognition, which involves identifying similarities, abstraction, which is about focusing on the most essential information, and algorithm design, which is about creating step-by-step solutions (Selby, 2015). In science education, CT becomes instrumental for students to order and display data, invent digital models, and obtain a well-organized grasp of the natural systems. Integrating CT into the science curriculum helps connect empathy with logic, application with theory. Students are allowed to observe that data is capable of narrating the human experience and that algorithms can be used not only for solving mathematical problems but also for dealing with social realities. The fusion of technology with social consciousness is, in fact, the core of the digitally-driven pedagogy of the 21st century whereby the students' learning outcomes include cognitive, digital as well as emotional literacy at the same time (Selby, 2015).

The integration of the 5E Learning Cycle and Computational Thinking is a strong step to deep transformative learning. The 5E model is the pedagogical framework which supports the stages of inquiry and reflection, while CT offers the cognitive tools that facilitate the organization of complex problems and the creation of clever solutions. Consequently, they generate an environment in which learners gain not only science knowledge but also use it to bring about positive changes. Here, the topic of menstrual cycle goes beyond human biology to agency of social innovation. Students employ digital tools to depict biological data, analyze social trends, and deliver empathetic messages. This is consistent with the view of Bybee (2006) who defines scientific literacy for social responsibility as the capability of using scientific knowledge to solve ethical and societal issues. Therefore, the integrated model of 5E and CT serves as a vehicle for engaging, thoughtful, and joyful learning. Learning that challenges the intellect, emotion, and conscience.

This study, in theory, is based on constructivist and socio-cultural learning theories. Learners are regarded as active participants who, through their interaction with the environment and collaboration with peers, construct their understanding. While dealing with menstruation stigma, students are portrayed as not just the passive recipients of knowledge, but as the co-creators of the solutions. They take the data to challenge tameness, use technology to educate, and through reflection, they get to know the feeling of others. In agreement with this, Chrisler (2013) states, "When we teach taboo topics, we teach courage, compassion, and critical thinking all at once."

The combination of menstrual education, the 5E Learning Cycle, and Computational Thinking places the learning of science as a link between knowledge and humanity. It reveals that technology and empathy can be two sides of the same coin in a lesson plan, and that coding can be a means of social transformation rather than just a simple product. These kinds of methods in low-resource schools demonstrate that innovations do not always have to be accompanied by expensive and sophisticated instruments; what is needed is just a well-thought-out design, its relevance, and the bravery. According to Baruah (2025), "education has the most amazing power when it becomes the power to build understanding that uplifts human dignity." Science will be one of the means through which kids will not only study nature but also develop empathy and become aware of their own power."

2. METHODOLOGY

2.1. Research Design

The research employed qualitative descriptive research design with elements of classroom action research, focusing on understanding how integrating computational thinking in science education could impact students' knowledge, attitudes, and empathy towards menstruation. The instrument was selected as it provided the teacher who was

also the researcher a chance to examine real learning experiences in the regular setting. The study was not about testing a hypothesis but rather describing and interpreting the results of an instructional intervention that combined the 5E Learning Cycle model with computational thinking in a real classroom context. The change happened in three sessions in the natural science subject area, the human reproductive system being the emphasis. The lesson plan combined Learning Cycle 5E (Engage, Explore, Explain, Elaborate, Evaluate) and the Computational Thinking framework (decomposition, pattern recognition, abstraction, and algorithm design).

Table 1. Learning Session

Session	Activities	Model/approach
Session 1 (70')	Discussion on the reproductive system and menstrual process; and conduct surveys with younger peers (Grades 5-8)	5E LC: Engagement
Session 2 (105')	Students analyse survey results using computational thinking steps and apply findings to design digital products.	5E LC: Exploration Explanation Elaboration CT: Decomposition Pattern recognition Abstraction Algorithm
Session 3 (75')	Students present and evaluate their digital products to younger peers; and reflect on learning outcomes and social impact.	5E LC: Evaluation

2.2. Participants of the Study

The main participants of this study were 25 ninth-grade students (ages 14–15) from SMPN 2 Karangploso Satu Atap, consisting of 17 female and 8 male students. These students took part in the full instructional intervention and served as the primary research subjects.

In addition, students from grades 7-8 in the same school and student grade 5-6 primary school from the same school cluster (ages approximately 11–13) were involved as survey respondents. They were not part of the intervention but contributed as data sources for the ninth graders' initial investigation phase. It was mandatory to bring these elementary students to make the 9th graders understand real problems of menstrual stigma which vary in different age groups. The surveys were done under the monitoring of teachers and the green light was given by the school administration to keep everything ethical and age-appropriate.

2.3. Instruments

Data collection employed three main instruments: (1) pre-learning surveys, (2) observation checklists, (3) reflective journals.

Pre-learning Surveys.

Two distinct questionnaires were created. A questionnaire for female students and a questionnaire for male students. Girls from grades 5–8 were the target of the female students' survey to collect data about the menstrual experience (cycle length, comfort level, hygiene practices, and knowledge sources). Boys from the same grade range were the target of the male students' survey to examine perceptions and misconceptions about menstruation. Each questionnaire had ten closed and open-ended questions aimed at obtaining factual and attitudinal data. These questionnaires were used as both a learning tool and research data for mapping menstrual stigma.

Observation Checklists

As a researcher, the teacher closely watched the classroom activities with the help of a structured observation form. The main focus was on the involvement of students, their cooperation, and gender interactions during the different phases of 5E. Some notes were also taken in the field right after every session to record student behaviour, their way of solving problems, and their emotional reactions to the talks about menstruation, which, in fact, were some of the newly arising themes.

Reflective Journals

Once students finished each session, they wrote brief reflections on what they learned, difficulties they faced, and changes in their thinking. These reflections served as a window to students' intellectual and emotional growth during the learning process.

2.4. Data Analysis Technique

Data analysis followed a qualitative descriptive approach using thematic analysis (Braun & Clarke, 2006). The process included four stages: data organization, coding, theme generation, and interpretation.

Data Organization: The complete set of field notes, student reflections, and feedback responses were documented and sorted based on data sources (survey results, observation, reflection, feedback). Quantitative data from the feedback questionnaire were utilized descriptively to provide evidence for qualitative findings.

Coding: Information were hand-coded to find the most frequently discussed concepts and the most common attitudes in the text related to (a) understanding of reproductive concepts, (b) empathy and perspective-taking, (c) digital literacy and problem-solving, and (d) gender interaction patterns.

Theme Generation: The words were combined to the overarching themes which not only reflected the changes in student understanding but also their social attitudes like "from taboo to openness", "science as empathy", and "coding as collaboration." Interpretation: The topics were understood in relation to the research goals and the theoretical framework of constructivism and computational thinking.

Cross-source triangulation was used to verify the results obtained through different methods or sources—survey data, observations, reflections, and feedback were compared to check the trustworthiness of the findings and to confirm the patterns that were emerging.

3. RESULT AND DISCUSSION

The following are the findings and the discussion presented based on the stated objectives of the study.

Finding 1: Improved conceptual understanding of the reproductive system. Analysis of students' written responses, reflections, and classroom observations revealed a clear improvement in conceptual understanding of the human reproductive system. During the Evaluation phase of the 5E cycle, 20 out of 25 students accurately described both the function of reproductive organs and the hormonal regulation of the menstrual cycle. Moreover, they were able to link scientific concepts with sociocultural issues that existed in their survey data. This aligns with the results of Beffa-Negrini et al. (2007), who found 5E-based learning to be a means of achieving long-term conceptual understanding through inquiry and reflection.

Finding 2: Development of Computational Thinking and Digital Literacy. Students were able to apply the CT components (decomposition, pattern recognition, abstraction, and algorithm design) to transform the raw survey data into digital outputs. During decomposition, students took apart the complex problems into smaller parts that they could handle: understanding cycle patterns, emotional responses, and misconceptions. After that, pattern recognition came, meaning that students found the patterns in the data. With abstraction, they decided on the essential variables that they would include in their digital products, thus, getting rid of the unnecessary data. Lastly, in algorithmic design, they devised logical steps to work out menstrual predictions or to facilitate educational content. This activity resulted in the production of two different websites with the help of Canva Code and ChatGPT as programming assistants. Female students developed a menstrual cycle tracker, while male students built a myth-busting-educational-site. Both results showed the employees' skills not only on the technical level but also on the empathy-driven level, which corresponds to the statement of Grover and Pea (2018) that computational thinking is a tool not only for analytical but also for ethical reasoning.

Finding 3: Increased confidence and agency among female students. A survey after the dissemination showed that 19 out of 25 girls of grades 5-8 reported that they felt "more confident" and "less embarrassed" when talking about menstruation. Reflection responses frequently highlighted a shift from embarrassment to self-acceptance, suggesting that learning activities helped normalize menstruation as a natural biological process rather than a private or shameful topic.

Finding 4: Growth of Empathy and Reduction of Menstrual Stigma among Male Students. 18 out of 24 boys stated "greater understanding" and "respect" of female peers. The present results are in accordance with the research of Johnston-Robledo et al. (2007) who pointed out that a detailed menstrual education program result in less stigma and more empathy among adolescents. Moreover, the observation data indicated a difference in the classroom mood. Boys were more involved in a thoughtful manner, and concurrently, there were no more casual jokes on menstruation.

The students' affective transformation, which was obvious in the behavior of the children, is also an acknowledgment of the learning's focus. The learning environment, which revolved around open discussion, collaboration, and real-life application, was the main factor in bringing about the commonality of menstruation among all human beings. The observed results are in agreement with Liu et al. (2009) who argue that emotion and cognition are interconnected when learning is based on authentic inquiry.

The findings support the view of Baruah (2025) that education has the potential to be a “transformative instrument” in breaking down myths and creating empathy. Here students didn't just study menstruation; rather they learned through menstruation by using data analysis, conversation, and coding as means of social awareness creation. By their work, they shortened the gap between biological sciences and human experience thus, becoming an instance of what Bybee (2006) calls scientific literacy for social responsibility.

The different pieces of evidence figure out that one of the leading reasons for the 5E Learning Cycle and Computational Thinking to have such a massive impact on scientific understanding to be the simultaneous use of these two approaches. The argument for the hallmark of this approach being its dual machinery is that it offers both cognitive support through a 5E framework and it also enhances systematic reasoning through CT. The students were guided through the well-organized stages of Engagement, Exploration, Explanation, Elaboration, and Evaluation in order to change their state of being simply curious to that of actually carrying out the action while, at the same time, CT provided a logical means for problem-solving and digital creation (Bybee et al., 2006; Wing, 2006; Selby, 2015).

4. CONCLUSION

The study brought to light the fact that integrating computational thinking in science instruction has a power impact on students' understanding, the way they apply and reflect real-world issues. The fusion of programming, scientific inquiry, and social awareness made the students to not only understand menstruation as a natural process but as a common human experience that is related to empathy, respect, and gender equity. Their learning journey- built through the 5E learning cycle and computational

steps- helped the students to bridge the gap between the theoretical knowledge and their lived realities.

Students' cognitive abilities were raised to a higher level as they became capable of giving more supporting explanations for the reproductive functions. Their psychomotor skills were developed as well when they became competent in designing and carrying out simple algorithms for making functional websites. Moreover, the most significant component of the first paragraph is that female students were able to collect self-esteem and body consciousness, while male students learned to show empathy instead of stigma. The change of behavior of male students towards being more positive is, therefore, a clear indication of the real success of the innovation when science becomes a medium for social understanding.

As a result, we can consider various practical proposals based on these points. First of all, teachers may use the approach as a model to integrate digital literacy with value-based teaching, thus getting students motivated to use technology in a manner which is not only logical but also caring. Schools, on the other hand, should focus on creating a climate that is conducive to the open discussion of even the most sensitive issues such as reproductive health so that empathy and respect among the genders can be developed. Lastly, the next generation of researchers, by studying computational thinking in various social or health-related scenarios, not only may deepen their understanding of the issue but also may uncover that digital learning can be an influential tool for social transformation.

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Implementation Of Digital Technology-Based Deep Learning in Elementary Schools: A Qualitative Study of Teacher Strategies and School Policies

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ABSTRACT

Technological developments in the digital era have brought significant transformations in the world of education, but learning in elementary schools is still largely focused on achieving grades without experiencing a deep and meaningful learning process. Deep learning has emerged as an alternative learning approach that emphasizes comprehensive conceptual understanding, contextual learning, and the development of 21st-century skills. This study aims to explore the learning strategies implemented by teachers, identify supporting school policies, investigate the obstacles faced, and design solutions for implementing digital technology-based deep learning in elementary schools. The study used a qualitative approach with a case study method. The research subjects were teachers, principals, and vice principals in the curriculum field who were selected using a purposive sampling technique with the principle of data saturation. Data collection was carried out through participant observation, semi-structured interviews, and documentation. Data validity was guaranteed through technical triangulation and source triangulation. Data analysis used the Miles and Huberman interactive analysis model consisting of data collection, data reduction, data presentation, and conclusions. The study results show that teachers implemented five main strategies: project-based learning, class discussions, teaching aids, contextual learning, and problem-based learning, with the integration of digital technology through instructional videos, digital simulations, and collaboration platforms. School policies supported this by providing ICT infrastructure, training, and comprehensive evaluation. Challenges faced included limited devices, unstable internet connections, limited device ownership, and diverse digital literacy. Solutions were developed through the use of rotating devices, offline applications, alternative non-digital materials, parent collaboration, and ongoing training. This study recommends strengthening digital teacher competencies, increasing infrastructure investment, developing adaptive policies, and building multi-stakeholder partnerships to support the implementation of digital technology-based immersive learning in elementary schools.

Keywords: *deep learning, elementary school, learning strategies, school policy keyword.*

1. INTRODUCTION

Technological developments in the digital era have had a significant impact on education, including at the elementary school level. Technology has accelerated the learning process, increased accessibility, and introduced new learning methods such as e-learning and blended learning (Almira, 2025). However, in schools, especially elementary schools, most students focus solely on grades and completing the curriculum, without truly experiencing in-depth and meaningful learning. This situation can be called "schooling without learning." In today's digital era, student-centered

learning is essential. One such concept is deep learning. Deep learning emphasizes contextual and meaningful learning (Khasanah et al., 2025). Deep learning also emphasizes learning based on students' real-life experiences. Furthermore, deep learning emphasizes the importance of metacognitive awareness, namely students' ability to monitor and control their own learning process (Khasanah et al., 2025). Deep learning emerged as a learning strategy that encourages students to think critically, reflect on experiences, and relate material to real life (Hardian et al., 2025). This concept also emphasizes a comprehensive understanding of concepts, the ability to relate new knowledge to previous experiences, apply knowledge in various contexts, and develop metacognitive skills. In deep learning, students not only answer "what," but also "why" and "how," and explore the relationships between concepts (Khasanah et al., 2025).

The implementation of deep learning in elementary schools is becoming increasingly crucial, given that the foundation of learning at this level will determine the quality of education at subsequent levels. Elementary school students are in the golden age phase of child development. During this period, children experience rapid cognitive, affective, and psychomotor growth (Susanti et al., 2025). Therefore, because children are in a period of good growth, in-depth learning is needed that is integrated with digital technology, because it seeks to increase the effectiveness of activities in the classroom (Sari & Munir, 2024). Furthermore, it has the potential to maximize the development of students' overall potential, as it can transcend conventional learning, which tends to be transmission-oriented and memorization-oriented, and foster curiosity, reflection, and critical thinking skills, also due to the positive developmental period. By fostering curiosity, reflection, and critical thinking skills, students can become lifelong learners (Sarnoto, 2025).

Several elementary schools in Indonesia, both public and private, have begun adopting a digital technology-based immersive learning approach in their teaching and learning processes. These schools also integrate various digital platforms, interactive learning applications, and technological devices to support deeper and more meaningful learning processes. However, much research has examined deep learning in depth. However, most of these studies focus on theoretical aspects or general technology implementation, without delving specifically into how teachers design learning strategies and how school policies support or hinder this process. However, the success of deep learning implementation depends heavily on the readiness and competence of teachers as learning facilitators, as well as conducive school policies that provide infrastructure, training, and support to the school community. This research gap raises important questions about real-world practice: what strategies teachers employ in implementing digital technology-based deep learning, what school policies support this implementation, what obstacles they encounter in the process, and what solutions can be developed to address these challenges. A thorough understanding of

these aspects is essential for providing practical recommendations for improving the quality of deep learning implementation in elementary schools.

Based on this background, this study aims to analyze teachers' learning strategies in implementing digital technology-based deep learning in elementary schools, examine supporting school policies, identify challenges faced by teachers and schools, and formulate alternative solutions to address these challenges. Specifically, the study seeks to explore the learning strategies applied, the role of school policies, the obstacles encountered, and the solutions developed in implementing digital technology-based deep learning. Using a qualitative approach, this study is expected to provide a comprehensive understanding of current practices and contribute both theoretically and practically to the development of elementary education in Indonesia.

2. METHODOLOGY

This research uses a qualitative approach with a case study method. This approach was chosen because this research aims to understand and describe in depth the phenomenon of implementing digital technology-based immersive learning in elementary schools. According to Sugiono qualitative research is research that is used to examine the conditions of natural objects, where the researcher is the key instrument (Ardiana, 2022). Qualitative research methods are grounded in post-positivist philosophy and conducted in natural settings, with the researcher as the main instrument. Data sources are selected purposively or through snowball sampling, data are collected using triangulation, and analysis is conducted inductively to emphasize meaning rather than generalization (Muhajirin et al., 2024). The case study method was used in this research to intensively and comprehensively explore teacher strategies and school policies in a real context in an elementary school environment. The case study research method is a type of research that can answer several issues or objects regarding a phenomenon (Yona, 2006). Case study research is a form of qualitative research that is based on events or situations, understanding and human behavior based on human opinion (Ilhami et al., 2024).

Through case studies, researchers can explore detailed and holistic information about how digital technology-based immersive learning is implemented, the challenges faced, and the efforts made by teachers and schools. The research subjects included teachers implementing digital technology-based deep learning, the principal, and the vice principal for curriculum. Subjects were selected using purposive sampling, a technique based on specific considerations aligned with the research objectives (Santina et al., 2021). The main objective of sampling is to reduce bias (perceptual deviation) and ensure that the selected sample represents the population well so that the research results can be applied more generally with the level of accuracy expected and planned by a researcher (Asrulla et al., 2023). Subject selection criteria included

teachers who had implemented digital technology-based learning for at least one year, schools with written programs or policies regarding the use of technology in learning, and subjects' willingness to participate in the research. The number of subjects was not determined in advance but was determined based on the principle of data saturation, which occurs when the information obtained no longer yields significant new findings.

Data collection in this study employed three main techniques observation, interviews, and documentation which were conducted simultaneously and complemented one another to obtain comprehensive and in-depth data. Observations were carried out using passive participant observation to examine classroom learning processes, including teachers' implementation of digital technology-based deep learning strategies, teacher–student and student–student interactions, the use of digital media, and the learning atmosphere. Data were recorded using observation guides, field notes, and visual documentation with school permission. Interviews were conducted using a semi-structured format to obtain deeper insights into teacher strategies and school policies related to immersive learning. Participants included teachers, the principal, and the vice principal for curriculum. Interview guides were used to ensure focus on key themes, and data were recorded using audio devices and supporting notes with informant consent. Documentation was collected to support and strengthen observational and interview data, including lesson plans, syllabi, school policy documents, curriculum files, digital learning media, student work, and photographs of learning activities. Documentation guidelines and checklists were used to ensure data completeness.

To ensure the validity and credibility of research data, triangulation techniques are used. Triangulation is a data checking technique that utilizes something other than the data itself for checking or as a comparison against the data itself (Husnullail et al., 2024). In this study, the triangulation used was technical triangulation and source triangulation. Technical triangulation was conducted by comparing data obtained from different data collection techniques on the same subject. For example, data on learning strategies obtained from interviews with teachers would be compared with the results of classroom learning observations and lesson plan documents prepared by the teachers. If these three data sources showed consistency, then the data were considered valid. If discrepancies were found, the researcher would double-check through discussions with the research subjects for clarification. Source triangulation was conducted by comparing data obtained from different sources using the same techniques. For example, information on school policies related to digital technology implementation obtained from interviews with the principal would be compared with information obtained from interviews with teachers and vice-principals, as well as with existing written policy documents. By comparing data from these various sources,

researchers could obtain a more comprehensive and credible picture of the phenomenon being studied.

Data analysis in this study used the interactive analysis model from Miles and Huberman. Miles and Huberman argue that qualitative data analysis must be carried out interactively and continuously until complete (Muliaan et al., 2024). Consists of data collection, data reduction, data presentation, and drawing conclusions or verification (Wandi et al., 2013). Data were collected simultaneously through observation, interviews, and documentation to obtain comprehensive information, with initial analysis conducted through reflective notes. Data reduction was carried out continuously by selecting, simplifying, and summarizing relevant information to identify key themes and patterns. The reduced data were then organized and presented clearly to support analysis. Conclusions were drawn iteratively and verified through additional data collection, field note review, member checking, and data triangulation. In qualitative research, conclusions represent new findings that clarify previously unclear phenomena.

3. RESULT AND DISCUSSION

Based on interviews with elementary school teachers, key findings were obtained regarding the implementation of digital technology-based immersive learning. These findings were then analyzed and discussed in accordance with the formulated research questions.

Learning Strategies Applied by Teachers in Implementing Digital Technology-Based Deep Learning in Elementary Schools

Interview results indicate that teachers understand deep learning as a process in which students not only memorize information but are able to connect it to their experiences, apply concepts to new situations, and demonstrate meaningful understanding. This understanding aligns with the concept of deep learning proposed by various education experts, where learning does not stop at the stage of remembering or understanding, but continues to the stages of applying, analyzing, evaluating, and creating. They learn to transfer knowledge to new contexts, solve real-world problems, and build 21st-century skills such as creativity, communication, collaboration, and critical thinking (Fatmawaty, 2024). At the elementary school level, deep learning is defined as students' ability to ask questions, explore, and create meaning from what they learn, rather than simply passively receiving information. This concept positions students as active constructors of meaning, rather than passive recipients of information, according to Zhao et al., in a 2022 study (Sappaile, 2025). I

n implementing immersive learning, teachers use a variety of varied and complementary learning strategies. The first strategy implemented is project-based

learning. Project-based learning provides opportunities for students to actively engage in exploration, collaboration, and problem-solving, which in turn stimulates their creativity (Taliak et al., 2024). This strategy allows students to develop critical thinking, collaboration, communication, and creativity skills in an integrated manner. Furthermore, by involving students in project planning and implementation, they learn to think critically, overcome obstacles, and develop innovative solutions (Yolanda & Mulyani, 2023). The second strategy is the use of class discussions and open-ended question-and-answer sessions. Teachers encourage students to ask questions, express their opinions, and discuss them with their classmates to build shared understanding. Teachers who are able to ask open-ended questions that stimulate students to think more deeply and discuss various perspectives successfully create an active and productive discussion atmosphere (Arifah et al., 2025). This method creates a dialogic and participatory learning environment, where students are not only recipients of information but also constructors of knowledge.

The third strategy used is the use of props or simple experiments. Learning with props provides concrete experiences for students, especially in elementary school, where students are still in the concrete operational stage. By using props, students can see the connection between the knowledge they gain and their surroundings, preventing them from becoming verbal (Latukau, 2023). The fourth strategy is connecting the material to students' daily lives. Teachers consistently strive to make learning contextual and relevant to students' experiences, so that the material learned has meaning and can be applied in real life. By improving students' ability to see material in everyday life, it is hoped that this will be one of their first steps in implementing the material taught in school in their social lives (Anissa & Lutfi, 2024). The fifth strategy is the problem-based learning model. In this strategy, students are presented with authentic problems that they must solve through investigation, analysis, and synthesis of information. Learning through the problem-based learning model is expected to empower students to become independent individuals and be able to face any challenges in their lives later in life (Ratnawati, 2021).

The integration of digital technology into these learning strategies is achieved through various means. Teachers utilize instructional videos to provide visualizations of concepts that are difficult to explain verbally or through text. Instructional videos help students understand processes, phenomena, or abstract concepts in a more engaging and accessible way. This medium is considered effective because it helps teachers deliver material in a way that is engaging and easy for students to understand (Astiyanah & Mastoah, 2025). Digital technology thus serves not only as a means of conveying information, but also as a medium that enriches the learning experience, facilitates deeper exploration of concepts, and provides a richer and more diverse range of learning resources. Therefore, technology is seen as facilitating access to diverse

learning resources and facilitating collaborative communication between students and teachers (Fatimah et al., 2024).

To encourage students to think critically, analyze, and solve problems, teachers use a learning approach based on higher-order thinking questions. These provocative questions go beyond memorizing or understanding, encouraging students to analyze, evaluate, and create. Teachers also present real-world problems to be solved collaboratively, enabling students to apply their knowledge in meaningful contexts. Furthermore, teachers encourage students to explain their understanding in their own words, an important indicator of deep understanding. Comparing, classifying, and predicting activities are also routinely integrated into learning to cultivate students' higher-order thinking skills. This aims to enhance students' critical and creative thinking abilities (Pasaribu et al., 2025)..

Students' in-depth understanding is assessed through a comprehensive range of methods. Teachers rely not only on written tests that measure factual knowledge but also assess students through project results, presentations, and their ability to re-explain concepts in their own words. Students' ability to apply knowledge to new situations and generate more in-depth questions is also an important indicator of in-depth understanding. Formative assessments such as rubrics and portfolios are used to document students' ongoing learning progress and provide constructive feedback. This holistic assessment approach aligns with the principles of authentic assessment, which measures not only final outcomes but also the student learning process.

School Policies in Supporting the Implementation of Digital Technology-Based Deep Learning

School policies play a crucial role in supporting the implementation of digital technology-based immersive learning. Technology-based education policies aim to improve the quality of learning through the integration of digital tools (Darmansah et al., 2025). Interview results indicate that the school has taken various strategic steps to create a learning ecosystem conducive to the implementation of deep learning. The primary support provided by the school is providing access to information and communication technology devices. This benefit includes facilitating access to knowledge and opening up opportunities for innovation in various fields such as education, economics, and government (Muhibuddin, 2023). The school has provided a variety of technological devices accessible to teachers and students, including computers, laptops, tablets, and projectors. The school also provides a computer laboratory as a dedicated space for technology-based learning. This computer laboratory is not only used for ICT subjects, but can also be utilized by teachers of other subjects to integrate technology into their teaching. The existence of a computer laboratory provides opportunities for students to interact directly with technology and

develop their digital literacy. Furthermore, the computer laboratory plays a crucial role as a supporting tool in the Information and Communication Technology (ICT)-based learning process (Siahaan et al., 2025).

In addition to providing infrastructure, schools also provide freedom and space for teachers to experiment with various learning applications. This relaxed policy, which allows for innovation, is crucial for fostering teacher creativity in designing effective and engaging learning. Schools also encourage the use of digital platforms for administrative and learning purposes. The use of platforms such as Google Classroom, learning management systems, or school communication applications is facilitated and supported by school policy. Schools also occasionally invite external speakers or facilitate teachers' participation in training provided by the education office. This collaboration with external parties enriches teachers' perspectives and knowledge about best practices in immersive learning and the use of technology. This ongoing and integrated training demonstrates the school's understanding of the importance of ongoing professional development in the digital age. The school comprehensively evaluates the success of learning programs oriented toward in-depth understanding. In addition to providing infrastructure, schools also provide freedom and space for teachers to experiment with various learning applications. This relaxed policy, which allows for innovation, is crucial for fostering teacher creativity in designing effective and engaging learning. Schools also encourage the use of digital platforms for administrative and learning purposes. The use of platforms such as Google Classroom, learning management systems, or school communication applications is facilitated and supported by school policy. Schools also occasionally invite external speakers or facilitate teachers' participation in training provided by the education office. This collaboration with external parties enriches teachers' perspectives and knowledge about best practices in immersive learning and the use of technology. This ongoing and integrated training demonstrates the school's understanding of the importance of ongoing professional development in the digital age. The school comprehensively evaluates the success of learning programs oriented toward in-depth understanding.

Obstacles Faced by Teachers and Schools in Implementing Digital Technology-Based Deep Learning

Despite the implementation of various strategies and policies, the implementation of digital technology-based immersive learning in elementary schools still faces various obstacles. The first obstacle is the limited availability of technological devices. Limited access to technological devices, such as laptops and smartphones, is the main obstacle (Lestari et al., 2025). Several interconnected obstacles hinder the implementation of digital technology-based learning. First, the limited number of devices in schools is often disproportionate to the number of students, requiring device rotation and

restricting learning effectiveness as well as the range of possible activities. Second, unstable internet connectivity disrupts access to online resources and digital platforms, particularly in areas with limited infrastructure. Third, unequal device ownership among students creates a digital divide, limiting learning opportunities outside school and potentially affecting learning outcomes. Fourth, varying levels of digital literacy among students and teachers require additional time for basic technical instruction and result in uneven technology integration. These challenges highlight the complex and interrelated nature of barriers to digital learning implementation. In addition to pedagogical challenges, infrastructure is a major obstacle to implementing deep learning in schools. Limited access to high-powered computers, stable internet connectivity, and cloud-based learning platforms are factors that slow down the integration of AI into education (Zahrok et al., 2025). These challenges require a systemic approach involving not only teachers and schools, but also parents, government, and other stakeholders. A thorough understanding of these constraints is essential as a foundation for developing effective and sustainable solutions.

Solutions to Overcome Obstacles to Implementing Digital Technology-Based Deep Learning

Based on experience and practice, teachers and schools have developed various solutions to overcome the obstacles they face. The first solution to overcome device limitations is to utilize existing devices in rotation. Teachers set schedules and learning strategies that allow students to use devices alternately or in groups, so that despite limited resources, all students still have the opportunity to access technology. Collaborative learning in small groups can also be a strategy to maximize the use of limited devices, where a single device is used by a group of students to work together to complete a task. Collaborative learning is a learning strategy that emphasizes cooperation between students or students and teachers in achieving better understanding, solving problems, or producing a product or outcome (Anwar et al., 2024). The second solution is to use offline applications. To anticipate the problem of unstable internet connections, teachers prepare learning materials and applications that can be run offline. Video materials, documents, or learning applications are downloaded in advance when a connection is available, so they can be used during learning without relying on a real-time internet connection. Because the materials can be prepared in advance by educators at home, internet use at the institution is limited to when needed, such as when searching for additional materials or incomplete materials (Candra & Susilo, 2022). The third solution is providing alternative non-digital learning materials, as teachers view technology as a support tool rather than the primary goal of learning. Printed textbooks, worksheets, physical props, and manual experiments are used to ensure inclusive learning for students with limited access to

technology. The fourth solution involves collaboration with parents to support technology use at home through effective communication, enabling teachers to understand students' home conditions and design learning that aligns with real-world contexts. The fifth solution is continuous teacher participation in professional development activities, such as workshops, webinars, learning communities, and independent online learning, to enhance digital competencies and maintain effective teaching practices in the digital era.

From a broader policy perspective, teachers emphasized the need for systemic support, including continuous training in educational technology and digital pedagogy, adequate access to devices and internet connectivity, reduced administrative burdens, and clear school policies that encourage innovation. Sufficient physical and digital infrastructure is essential to support effective learning implementation. Overall, the findings indicate that digital technology-based immersive learning in elementary schools is a complex process requiring synergy among teacher competence, supportive school policies, adequate infrastructure, and stakeholder collaboration. Despite existing challenges, teachers and schools demonstrated strong commitment and creativity in developing practical solutions, which can serve as a foundation for best practices and more effective policies in supporting immersive learning at the elementary level.

4. CONCLUSION

Based on the findings and discussion above, the conclusions that can be obtained include: Teachers have implemented digital technology-based deep learning through varied and complementary strategies that emphasize meaningful understanding, knowledge integration, and real-life application over rote memorization. These strategies including project-based learning, problem-solving, and contextual learning are integrated with digital tools such as simulations, interactive quizzes, and online collaboration platforms to boost engagement. This approach is mirrored in assessment practices that focus on higher-order thinking skills through portfolios and presentations, all of which are supported by school policies that provide ICT infrastructure and teacher autonomy. However, the transition faces challenges like unstable internet access and varying levels of digital literacy. To counter this, schools utilize device-sharing, blended learning, and continuous teacher training. Ultimately, the effective implementation of this model requires a synergy between teacher competence, supportive policies, and stakeholder collaboration to successfully foster 21st-century skills in students.

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Deep Learning Through Teaching Factory

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ABSTRACT

In mid-2025, the Ministry of Primary and Secondary Education of Indonesia launched a deep learning initiative to improve the quality of education nationally. Deep learning is an approach that stimulates students to learn mindfully and attentively (mindful), find meaning and relevance of what is learned to their lives (meaningful), and enjoy the learning process with enthusiasm and passion (joyful). As a new initiative, deep learning is certainly not immediately fully understood by schools, although some teachers have actually implemented it. One of mindful, meaningful, and joyful learning implementations in vocational secondary schools is the teaching factory. Teaching factory provides students with experiential learning based on industry in the school environment. This article aims to provide a conceptual analysis of the deep learning framework in the implementation of the teaching factory learning model in vocational secondary schools. This analysis is expected to help vocational secondary schools understand deep learning and its application in a vocational context. The results of the conceptual analysis on the dimensions of graduate profiles, learning principles, learning experiences, and learning frameworks indicate that teaching factory is an operationalization of the deep learning concept in vocational secondary schools.

Keywords: *deep learning, teaching factory, vocational secondary school.*

1. INTRODUCTION

In mid-2025, the Ministry of Primary and Secondary Education of Indonesia launched an educational transformation through deep learning. This was realized through regulations, curriculum revision, and guidelines. As a new initiative, it will certainly take time for the public to fully understand this, although some teachers have already implemented it.

Deep learning in education initially emerged from a study conducted by Marton and Saljö (1976) regarding two levels of processing: deep-level processing and surface-level processing. Biggs (1987) later defined deep learning strategies as meaningful learning, involving extensive reading and connecting with relevant prior knowledge. Bentz (1992) explained that deep learning stimulates learner maturity, which aligns emotional and intellectual expression. Hattie and Donoghue (2016) define deep learning as seeking meaning, relating and extending ideas, looking for patterns and underlying principles, checking evidence and relating it to conclusions, examining arguments cautiously and critically, and becoming actively interested in course content. In the Indonesian context, deep learning is defined as an approach that honors human dignity by fostering a learning atmosphere and process that are mindful, meaningful,

and joyful. It integrates holistic and interconnected processes of intellectual, ethics, aesthetic, and kinesthetics that engage learners in learning. Deep learning framework consists of four components, namely (1) dimensions of graduate profile, (2) learning principles, (3) learning experiences, and (4) learning framework (Suyanto et al., 2025).

Figure 1. Deep learning framework (Suyanto et al., 2025)

Deep learning encourages students to learn mindfully and attentively, enjoy the learning process with enthusiasm and passion, and discover the meaning and relevance of what they learn to their lives. This allows students to be actively engaged, connect new knowledge with previous experiences, and build understanding that has a long-lasting impact (Ministry of Primary and Secondary Education, 2025). This deep learning approach is applied at all levels of education, including vocational secondary schools.

In 2016, the Indonesian government through Presidential Instruction Number 9, issued instructions to revitalize vocational secondary schools. One of these initiatives is the alignment of vocational secondary school curricula with a link and match approach. Djojonegoro (1998) stated that "link" refers to the connection between vocational learning and the working world and "match" refers to graduates who meet workplace standards. Therefore, "link and match" can be interpreted as an effort to align the learning process and graduates to meet the needs of the working world. One link and match strategy is to develop a teaching factory.

The teaching factory concept has evolved over time. According to Chryssolouris et al. (2006, 2016), the teaching factory paradigm aims to align teaching and training with industry needs through the effective integration of education, research, and innovation, as well as the involvement of industry and academia. According to Sutopo et al. (2017), a teaching factory is an activity in vocational education that produces goods or services managed by teachers and students. From a learning perspective, Sudiyanto et al. (2011) defines a teaching factory as a learning activity in which students directly carry out production activities, either in the form of goods or services, within a school environment. Kuswantoro (2014) and Khurniawan et al. (2016, 2021) state that a teaching factory is a learning concept in real conditions to bridge the

competency gap between the knowledge provided by schools and the needs of industry. The Indonesia Directorate of Vocational Secondary Schools or Direktorat SMK (2023) defines a teaching factory as a learning model that integrates the achievement of school curriculum competencies and production processes in accordance with workplace procedures and standards, to produce competent and character-based graduates through the completion of products as learning media in the form of goods and/or services. Although using the term factory, the physical form does not have to be a manufacturing production line because a teaching factory can produce goods or services. It can be a farm, a barn, a greenhouse, a workshop, a studio, a hotel, a restaurant, a kitchen, a service office, or a retail sales unit. The concept of a teaching factory is in line with the Prosser & Quigley (1950) theorem, where vocational education will be effective in proportion as it trains the individual directly and specifically in the thinking habits and the manipulative habits required in the occupation itself.

Since a teaching factory is a learning model, it has stages or a learning syntax (Sani, 2013). The sequence of activities in a teaching factory, according to various sources, can be outlined as follows:

1. Problem analyzing, where students analyze the needs of potential product users (the community or partners in the workplace). For teaching factories with established markets, students at this stage must learn about the product market.
2. Product designing, where students, along with teachers or industry partners, design and develop a prototype of the product, including packaging, if necessary. For teaching factories with established products, students at this stage must study the product.
3. Organizing the production process, where students, along with teachers or partners in the workplace, organize resources, organize workflows, and schedule schedules. For teaching factories with established business processes, students at this stage must learn work procedures.
4. Implementing the production process, where students work according to the organization, both individually and collaboratively, conducting quality control, and making follow-up improvements (if necessary) to the resulting product.
5. Marketing the product, where students market or participate in marketing teaching factory products to the public or partners in the workplace.
6. Evaluating the production process, product, and documents, where students, along with teachers or partners in the workplace, conduct evaluations as part of quality assurance and continuous improvement efforts (Direktorat SMK, 2023; Damarjati, 2025).

Based on this syntax, the teaching factory that encourages student engagement is quite relevant to deep learning. This study aims to analyze the implementation of deep learning through the teaching factory in vocational secondary schools.

2. METHODOLOGY

This research employed a deep conceptual analysis method based on existing literature resources. The data used in the conceptual analysis came from a literature search using a berrypicking technique in several journals, books, and academic manuscripts on the topic discussed through web browsers and examining citations of several concepts within the literature. The search query evolved based on the depth of information needed and the results of previous searches (Bates, 1989). The researchers searched literature including books, journals, regulations, and official presentations published without a specific timeframe because some old concepts and theories related to deep learning, teaching factory, and vocational education are still relevant today. However, publications published in the last 10 years are prioritized.

The collected literature was then analyzed using conceptual analysis techniques, which treats concepts as classes of objects, events, properties, or relationships. The technique involves precisely defining the meaning of a given concept by identifying and specifying the conditions under which any entity or phenomenon could be classified under the concept in question. (Furner, 2004) This technique was used to analyze the relationship between the concepts of deep learning and the teaching factory, obtained from various literature sources.

3. RESULT AND DISCUSSION

Teaching factory builds dimensions of graduate profile

Billett (2011) states that vocational education has objectives that focus on: (1) preparation for entering work including selecting the type of work, (2) initial preparation of individuals for working life, including developing the capacity to practice skills in the chosen job, (3) development of ongoing competencies, and (4) education and experience that supports the transition of work positions from one position to another. The World Economic Forum (2025) outlines several skills that are most needed by the world of work in 2025 which are grouped into cognitive skills, engagement skills, ethics, management skills, physical abilities, self-efficacy, technology skills, and working with others.

One of the benefits of the teaching factory is to improve the soft skills and hard skills of vocational school graduates according to the demands of the working world (Direktorat SMK, 2023). These skills are obtained by students from managing work activities, teamwork, and interacting with customers. This occurs because the teaching factory learning process is designed and implemented based on actual work procedures and standards to produce goods or services that are in accordance with market or customer demands. The skills that students will gain through teaching factory learning include (1) entrepreneurial character, in the form of the ability to overcome obstacles/barriers that usually make people stop; (2) competitive skills, in the form of

innovation, efficiency, and creativity; (3) problem-solving skills, and decision-making; (4) basic entrepreneurial skills, in the form of the ability to design business plans, production plans, financial plans, and relationships with customers; (5) the ability to communicate with customers; (6) customer-oriented production skills; and (7) natural interaction with the industry. The teaching factory also builds honesty, discipline, the ability to work in teams, independence, and student self-confidence (Khurniawan et al., 2016). The skills obtained through the teaching factory are closely related to the deep learning graduate profile dimensions.

Deep learning is focused on achieving eight dimensions of graduate profiles which are complete competencies that must be possessed by every student after completing the learning process (Suyanto et al., 2025; BSKAP, 2025). The dimensions are derived from the Indonesian national education goal as stated in Law Number 20 of 2003 that is the development of students' potential to become human beings who believe in and fear God Almighty, have noble character, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens. In addition, the graduate profile dimensions are also inspired by 6 global competencies, namely: character, citizenship, collaboration, communication, creativity, and critical thinking. These competencies include compassion, empathy, socio-emotional learning, entrepreneurship, and related skills to function in a complex world (Fullan et al., 2018; Quinn et al., 2020). The following is a comparison of the dimensions of deep learning graduate profile and teaching factory.

Table 1. Comparison of the dimensions of graduates profile of deep learning and teaching factory

Dimensions and sub-dimensions of graduates profile (Suyanto et al., 2025; BSKAP, 2025)	**Teaching factory (Khurniawan et al., 2016; Subdit Kurikulum, 2020)**
Faith and devotion to God Almighty, with sub-dimensions of relationships with God Almighty, relationships with fellow human beings, and relationships with the environment	Honest, disciplined, and efficient in utilizing resources
Citizenship, with sub-dimensions of local, national, and global citizenship	Behave according to the rules and norms at work
Critical thinking, with sub-dimensions of delivering arguments, decision-making, and problem solving	Problem solving and decision making
Creativity, with sub-dimensions of developing new ideas, flexibility of thinking, and developing work	Innovation and creativity in developing products
Collaboration, with sub-dimensions of caring, sharing, and cooperation	Working in a team
Independence, with sub-dimensions of responsibility, leadership, and self-development	Independence

Dimensions and sub-dimensions of graduates profile (Suyanto et al., 2025; BSKAP, 2025)	Teaching factory (Khurniawan et al., 2016; Subdit Kurikulum, 2020)
Health, with sub-dimensions of clean and healthy living, fitness, physical health, and mental health, and environmental health	Creating a safe, clean and healthy work environment
Communication, with subdimensions of listening, speaking, reading, and writing	Ability to communicate with customers and interact with industry

Teaching factory applies the deep learning principles

Learning principles are a crucial foundation for ensuring effective learning. Three key principles of deep learning are mindful, meaningful, and joyful. These three principles complement each other in building deep learning for students (Suyanto et al., 2025). The relationship between these three principles and the teaching factory can be analyzed as follows.

1) Mindful

Mindfulness is a flexible state of mind in which we are actively engaged in the present, noticing new things and sensitive to context. Mindfulness results in an increase in competence; an increase in memory, creativity, and positive affect; a decrease in stress; and an increase in health and longevity. Mindful learning engages people in what they are learning, and the experience tends to be positive (Langer, 2000). In deep learning, students engage in issues and tasks of value to students and the world (Fullan et al., 2018). Mindful learning involves students' total involvement in the learning process, increasing awareness of their thoughts, feelings, and surroundings (Suyanto et al., 2025).

In a teaching factory, students must thoroughly understand the customer, product, and work procedures before engaging in the production stage. Students then produce and/or market the product under the supervision of teachers or industry partners. These production activities are carried out continuously so that students receive maximum benefits (Widjajanti et al., 2017). The full involvement of students in this learning process illustrates that the teaching factory applies the mindful principle.

2) Meaningful

Biggs (1987) defined meaningful learning as reading widely and interrelating with previous relevant knowledge. Deep learning transforms learning by focusing on material that has personal and collective meaning (Fullan et al., 2018). Ausubel (1962) stated that meaningful learning occurs when something students learn is linked to previously learned concepts. Deep learning adheres to the principle of meaningful learning because it prioritizes comprehensive understanding of the material, not just memorization (Suyanto et al., 2025). Acquiring knowledge through deep learning is a

good way to understand meaning. This increases learning efficiency and long-term retention (Kovač et al., 2025).

In a teaching factory, students plan, implement, and evaluate production based on what they've learned in the classroom or in the workshop. This is a meaningful characteristic of a teaching factory. Furthermore, dynamic interactions with customers and the team also provide students with new knowledge that builds on what they've learned previously.

3) Joyful

Deep learning occurs when teachers create a learning environment that challenges, provokes, stimulates, and celebrates learning (Fullan et al., 2018). Deep learning is beneficial for learners, increases motivation, and is "fun" (Kovač et al., 2025). Students can find joy in learning by having a deeper understanding of the topic (Tang, 2024). Joyful deep learning focuses on positive emotions related to the learning process, including curiosity, enthusiasm, and motivation. Deep learning accelerates a sense of well-being because it challenges students to explore complex ideas (Suyanto et al., 2025).

In a teaching factory, students are faced with the responsibility of completing production to ensure customer satisfaction. This sense of responsibility motivates them to perform well in completing tasks (Hou et al., 2022). Furthermore, the challenge of achieving customer satisfaction and completing tasks with high quality motivates students to learn new things or revisit previously learned material. This must be supported by a safe, comfortable, and conducive work environment. A better or more conducive work environment will increase work motivation (Prakoso et al., 2014).

Teaching factory provides deep learning experience

Learning experiences are created by the processes individuals undergo in acquiring knowledge, skills, attitudes, or values. These experiences occur in various settings, such as at school, work, home, or in everyday life, and involve interactions with subject matter, teachers, peers, or the environment. Deep learning provides students with learning experiences through the process of understanding, applying, and reflecting (Suyanto et al., 2025).

One taxonomy that is suitable for deep learning is the SOLO (Structured of Observed Learning Outcome) taxonomy (Fullan et al., 2018). The SOLO taxonomy classifies learning outcomes in terms of their structural quality, which makes it useful for defining levels of understanding (Biggs and Tang, 2011). Hook (2018) in a Q&A session with Roberts stated that the SOLO taxonomy makes surface learning and deep learning more visible. The SOLO taxonomy consists of 5 levels. The first level, prestructural, represents irrelevant or failed responses. The next two levels, unistructural and multistructural, relate to shallow learning. The last two levels relate

to deep learning (Smith & Colby, 2007). Biggs and Tang (2011) stated that the unistructural and multistructural levels relate to increasing knowledge, while the relational and extended abstract levels relate to deepening understanding. The analysis of learning experiences using the SOLO taxonomy and teaching factory can be described as follows.

1) Understanding

Understanding in deep learning experiences is a phase that aims to build students' awareness of learning objectives, encouraging students to actively construct knowledge so that students can deeply understand concepts or materials from various sources and context (Suyanto et al., 2025). Learning outcomes in the understanding learning experience are relevant to the unistructural level that increases to the multistructural level in the SOLO taxonomy because they are related to knowledge construction. (Biggs and Tang, 2011)

In the teaching factory, the stages of analyzing problems and designing products encourage students to understand the market/consumer (market knowledge) and the product (product knowledge). Therefore, both learning stages are relevant to the learning experience of understanding in deep learning.

2) Applying

Applying is a learning experience that demonstrates students' activities in applying knowledge contextually. This stage provides opportunities for students to apply knowledge both individually and collaboratively (Suyanto et al., 2025). Learning outcomes in the application learning experience are relevant to the relational level in the SOLO taxonomy because they relate to students' efforts to structure and integrate various knowledge that has been learned but is still within the scope of what was taught in the previous phase (Biggs and Tang, 2011).

In a teaching factory, the stages of organizing and implementing the production process are efforts to apply the knowledge of markets and products in the form of production activities for goods or services. This makes the stages of organizing and implementing the production process relevant to the learning experience applied in deep learning.

3) Reflecting

Reflecting is a process where students interpret the process and results of the actual actions or practices they have undertaken. The reflecting stage involves self-regulation as an individual's ability to manage their learning process independently, including planning, implementing, monitoring, and evaluating their learning methods (Suyanto et al., 2025). In the reflective learning experience, students are not only asked to repeat or recall the material they have learned, but are also directed to critically reconstruct their understanding, connect it to a broader context, and identify

implications or possible applications in different situations (Puskurjar, 2025). Learning outcomes in the reflective learning experience are relevant to the extended abstract level in the SOLO taxonomy because they relate to students' efforts to go beyond what has been applied in the previous phase to a new context or dimension (Biggs and Tang, 2011).

In the teaching factory, the product marketing stage is a learning step where students who have been able to carry out the production process and understand the product and its market/consumers can market their products through various media and deal with various consumer characteristics, both directly and indirectly. Through marketing, students will communicate the product and obtain consumer feedback for the evaluation stage. In the evaluation stage, students conduct a comprehensive reflection on the analysis, design, process, product, and marketing to improve quality in the next production cycle. Based on this explanation, it can be concluded that the marketing and evaluation stages are relevant to the learning experience of reflecting on deep learning.

Teaching factory applies deep learning's learning framework

In the deep learning framework developed by Fullan et al. (2018), there are four elements of learning design. These four elements encourage better learning design by providing direction and precision in the integration of pedagogical practices, learning partnerships, learning environments, and leveraging digital. In contrast to Fullan's concept, deep learning in Indonesia uses the term learning framework as a systematic guide to creating an educational ecosystem that supports learning. The main focus of this framework is to encourage meaningful, reflective, and contextual learning through planned practices, environments, and partnerships (Suyanto et al., 2025). This learning framework is inspired by four elements of learning design: pedagogical practices, learning environments, learning partnerships, and digital utilization.

1) Pedagogical practices

Pedagogical practices refer to the teaching strategies teachers choose to achieve learning objectives and achieve the dimensions of graduate profile. To achieve deep learning, teachers focus on authentic student learning experiences, prioritize real-world practice, and encourage higher-order thinking skills and collaboration (Suyanto et al., 2025). Deep learning can be achieved by combining currently recognized effective pedagogical practices such as inquiry learning, problem-based learning, cooperative learning, formative assessment, and summative assessment with emerging innovative pedagogical practices such as online learning, blended learning, gamification, game-based learning, e-portfolios, and feedback analysis (Fullan et al., 2018).

Teaching factories, as an extension of production-based learning (Khurniawan et al., 2016), provide authentic, hands-on learning experiences where students apply

competencies learned in class or previously practiced in laboratories, workshops, studios, practice fields, or other simulated settings to real-world situations using standard operating procedures. This strategy represents the application of deep learning pedagogical practices.

2) Learning environments

Fullan et al. (2018) stated that researchers and practitioners from various educational disciplines believe that the learning environment is the "third teacher" that can improve the quality of learning that optimizes student potential. The learning environment emphasizes the integration between physical space, virtual space, and learning culture to support deep learning (Suyanto et al., 2025). By integrating these three aspects, the learning process not only supports knowledge development but also shapes students into adaptive and independent learners. For example, the use of virtual laboratories can also train students to conduct virtual lab work before actual lab work (Bunyamin, 2021). This strategy stimulates student capability to learn independently.

Teaching factory learning activities and interaction not only take place in physical spaces but also in virtual spaces. There is interaction in the form of coordination, collaboration, sharing of knowledge, experiences, skills, expertise, feedback, and support, which are characteristics of an organization's learning culture. (Halmaghi and Todăriță, 2023). Therefore, it can be concluded that the teaching factory implements learning environments that support deep learning.

3) Learning partnership

Learning partnerships foster dynamic relationships between teachers, students, parents, communities, and professional partners. This approach shifts control of learning from the teacher to collaborative learning (Suyanto et al., 2025). In deep learning, students can act as co-designers and co-learners. The key to student engagement in deep learning is metacognitive skills, meaningful relationships, a caring environment, and openness to student aspirations (Fullan et al., 2018). In vocational secondary schools, teachers can partner with professionals from the professional world to contextualize learning as guest teachers. Guest teachers collaborate with classroom teachers to improve their own competencies and those of students (Maharani et al., 2024).

The teaching factory is created through, at a minimum, collaboration between teachers and students. Teachers act as supervisors, and students act as the backbone of product production and marketing. In an ideal teaching factory, industry partners are involved, consistently aligning learning activities with production processes in the workplace. Some industry partners are even willing to donate production facilities or build production lines at educational institutions. In the teaching factory, partnerships

between teachers, students, and industry practitioners are naturally occurring and integral to the learning process.

4) Leveraging digital

The use of digital technology also plays a crucial role as a catalyst for creating more interactive, collaborative, and contextual learning (Suyanto et al., 2025). The leveraging digital dimension relates to the interaction between teachers, students, and all parties involved in learning using digital technology to improve the quality of learning (Fullan et al., 2018). Digital technology can be utilized in planning, implementation, and assessment.

The teaching factory can be optimized through the use of digital technology. Product analysis and design can be carried out collaboratively through cloud computing or using AI as a tool. Product designs can be communicated through social media or messaging apps. For software products, product development can also be carried out collaboratively through computer networks or the internet. Product marketing can also now be done through digital marketplaces or social media.

4. CONCLUSION

The Ministry of Primary and Secondary Education of Indonesia is transforming education through deep learning. This educational transformation also impacts vocational secondary schools. One learning model in vocational secondary schools is the teaching factory. The teaching factory provides a holistic, industry-based learning experience within the school environment.

This study conceptually analyzes deep learning and the teaching factory. The analysis of deep learning graduate profile dimensions, learning principles, learning experiences, and learning framework shows that teaching factory is an operationalization of the deep learning concept in vocational secondary schools.

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Meaningful and Joyful Learning in The Digital Era: Islamic and Christian Faith-Based Schools in Indonesia

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ABSTRACT

The Indonesian education landscape is shifting toward the Deep Learning approach, which emphasizes mindful, meaningful, and joyful learning as the foundations for holistic student development (Kemendikdasmen, 2025). In the digital era, with an abundance of information and rapid technological advancements, strengthening character, reflection, and spiritual awareness has become increasingly essential (Gulo & Tapilaha, 2024). This creates opportunities for faith-based schools to integrate spiritual values into active and contextual pedagogy (Saukah, 2025). Yet, limited research examines how meaningful and joyful learning aligns with Islamic and Christian educational values. This study addresses this gap by examining how Deep Learning principles relate to religious values and how they are implemented at SMA Muhammadiyah 1, Yogyakarta, and SMA IPH Surabaya. Using a qualitative literature review and comparative interpretative analysis, the study draws on seventeen sources, including national Deep Learning policy documents, educational literature, religious texts, and school-level documents. The data were analyzed thematically to identify shared principles and distinctive emphases across Islamic and Christian educational perspectives. The findings indicate that both traditions emphasize self-transformation through reflection, moral responsibility, and a commitment to service. SMA Muhammadiyah 1 Yogyakarta emphasizes *akhlak*, social responsibility, and *ilmu–amal*, while SMA IPH Surabaya focuses on faith reflection, spiritual academic balance, and service learning. The study concludes that integrating spiritual values enriches meaningful and joyful learning by strengthening ethical awareness, empathy, and purposeful engagement, which are essential competencies for responsible learning in the digital era.

Keywords: *Deep Learning, Faith-Based Schools, Integration of Spiritual Values, Islam and Christianity, Meaningful and Joyful Learning.*

1. INTRODUCTION

Educational reform in Indonesia positions Deep Learning as a key direction for improving learning quality, emphasizing mindful, meaningful, and joyful processes as the foundation for holistic development (Kemendikdasmen, 2025). This framework aligns with global perspectives that highlight deeper learning, student agency, and purposeful engagement (Fullan & Langworthy, 2014; Darling-Hammond *et al.*, 2020). In this view, Deep Learning integrates cognitive, emotional, and spiritual dimensions to make learning more grounded and personally relevant for students.

In today's digital era, characterized by an abundance of information, rapid technological advancements, and shifting social interactions, traditional lecture-based approaches are increasingly misaligned with students' learning needs (Kassab *et al.*,

2025; Haleem *et al.*, 2022). Strengthening reflective habits, character formation, and spiritual awareness has therefore become essential for supporting responsible and ethical learning (Gulo & Tapilaha, 2024). These conditions create opportunities for faith-based schools to integrate spiritual values into active, contextual, and relational pedagogy (Saukah, 2025).

However, despite the growing emphasis on character formation and holistic development within the Deep Learning framework, existing studies in the Indonesian context remain focused mainly on policy discourse and general pedagogical principles. There is limited academic literature that explicitly examines how meaningful and joyful learning is consciously articulated and enacted within faith-based school practices. In particular, limited attention has been given to how Islamic and Christian educational values shape the interpretation and implementation of Deep Learning at the school level. As a result, the role of religious perspectives in informing meaningful and joyful learning remains underexplored within Indonesia's plural educational landscape.

To address this gap, this study examines how Deep Learning is interpreted and implemented within faith-based high schools in Indonesia, with particular attention to Islamic and Christian educational values. Drawing on cases from SMA Muhammadiyah 1 Yogyakarta and SMA IPH Surabaya, the study explores the implications of aligning faith, knowledge, and meaningful, joyful learning in the digital era.

2. METHODOLOGY

Research Design

This study employs a qualitative interpretive research design, drawing on literature and document analysis. Qualitative approaches are appropriate for exploring meaning, values, and interpretations embedded within educational concepts and practices, particularly when examining how policy frameworks and religious perspectives are understood and enacted in academic contexts (Creswell, 2013; Merriam & Tisdell, 2016).

Data Sources

The data sources consist of seventeen documents, including national policy texts on Deep Learning, peer-reviewed educational literature, Islamic and Christian educational writings, and selected school-level documents from SMA Muhammadiyah 1 Yogyakarta and SMA IPH Surabaya. These sources were purposively selected based on their relevance to the study's focus on meaningful and joyful learning, religious values, and faith-based education.

Data Analysis

Data were analyzed using thematic analysis. The documents were read iteratively to identify recurring concepts related to meaningful learning, joyful learning, character formation, and spiritual values. Initial codes were generated inductively and then organized into broader themes that reflect shared principles and distinctive emphases across Islamic and Christian educational perspectives (Braun & Clarke, 2006).

Trustworthiness

To enhance the study's trustworthiness, data triangulation was employed by comparing insights across policy documents, academic literature, and school-level texts. Reflexive analysis was also used to ensure transparency in interpreting values and meanings within the documents under analysis (Lincoln & Guba, 1985).

3. RESULTS AND DISCUSSION

3.1. Deep Learning in the Indonesian Context

The Indonesian Deep Learning framework defines learning as a mindful, meaningful, and joyful process that engages students' thinking, emotions, values, and actions. Within this approach, meaningful learning connects knowledge with real-life experiences and a moral purpose. In contrast, joyful learning nurtures intrinsic motivation and emotional well-being as students discover their purpose in learning. This aligns with Fullan and Quinn's (2018) view that Deep Learning enables students to "engage the world and change the world."

In today's digital era, characterized by an abundance of information, rapid technological advancements, and shifting social dynamics, these principles are becoming increasingly essential for fostering students' identity, character, and competence. Deep Learning promotes reflective and relational learning, helping students interpret their experiences and contribute responsibly within a complex technological landscape.

3.2. Religious Perspectives on Meaningful and Joyful Learning

3.2.1. Islamic Perspective

Islamic educational philosophy views learning as a unified process that integrates faith, knowledge, character, and social responsibility. Classical and contemporary Islamic education literature also highlights this unity, emphasizing that learning must cultivate ethical character, commitment, and devotion to God (Nata, 2012; Arifin, 2017; Azra, 2015). Saukah (2025) highlights that Islamic learning encourages students to read both *ayat-ayat qauliyyah* (revelation) and *ayat-ayat kauniyyah* (signs in creation), fostering reflective engagement and ethical discernment. This foundation aligns closely with the principles of meaningful learning, which in Islam connects intellectual

understanding (*'ilm*) with spiritual awareness (*īmān*). The Qur'an affirms this relationship (QS Al-Mujādilah 58:11), positioning the pursuit of knowledge as both an intellectual and spiritual calling. Accordingly, learning is considered meaningful when it cultivates virtues such as justice, responsibility, compassion, and ihsan (QS An-Nahl 16:90), thereby enabling students to move beyond cognitive mastery toward noble character and social responsibility.

Joyful learning in Islam is rooted in *rahmah*, which is a caring, gentle, and emotionally safe environment that reflects the Prophet's example of empathy and compassion (QS Ali 'Imrān 3:159). Joy is understood not merely as entertainment but as intrinsic satisfaction derived from understanding, connection, and contribution to others. Classrooms grounded in *rahmah* encourage curiosity, creativity, and expression without fear, allowing students to ask questions, explore ideas, and discover meaning with confidence. Islamic traditions of reflective inquiry further enrich this process. Learners are encouraged to contemplate creation, interpret real-world phenomena, and connect their observations with spiritual insight (QS Fussilat 41:53). Through this reflective stance, learning becomes a holistic activity that strengthens moral awareness, nurtures a sense of purpose, and supports responsible engagement with contemporary challenges.

3.2.2. Christian Perspective

Christian education views learning as a holistic process that forms the mind, heart, and character in alignment with God's purpose. Human beings are created in the image of God (Genesis 1:26) and entrusted to steward creation with wisdom and integrity (Genesis 1:28). Learning becomes meaningful when students recognize their God-given call and develop the knowledge, skills, and character needed to contribute responsibly to their communities (Van Brummelen, 2009; Smith & Smith, 2011; Romans 12:2). Teaching is described as a relational practice in which teachers guide students to discover meaning, connect learning to real-life contexts, and grow in character (Goodson, 2014; Oppewal, 2016). Meaningful learning, therefore, encourages students to link understanding with compassion, responsibility, and service toward others (Matthew 22:39).

Joyful learning arises from experiencing God's love, grace, and faithful presence. Classrooms are understood as communities of care where students feel safe, valued, and supported in their learning (Goodson, 2014). Joy is expressed through curiosity, gratitude, and wonder toward God's creation, enabling students to engage with openness and hope. Teachers model Christ-like attitudes, such as patience, empathy, and encouragement, creating an environment that fosters exploration, reflection, and collaboration. Christian educational practices such as reflection, service learning, and purposeful collaboration (Randall, 2003; Prabhu Das, 2021) help students recognize

how their gifts can bless others. Within this framework, joyful learning is not merely entertainment; it is the result of a nurturing and purposeful environment that supports academic growth, spiritual formation, and meaningful contributions.

3.3. Comparative Analysis: Islamic and Christian Perspectives

The comparative analysis reveals both shared foundations and complementary emphases in how Islamic and Christian educational traditions conceptualize and enact meaningful and joyful learning.

3.3.1. Shared Foundations of Meaningful and Joyful Learning

The analysis indicates that Islamic and Christian perspectives share several foundational commitments that support meaningful and joyful learning. Both traditions view faith as the basis for moral and character formation, positioning education as a process that shapes responsible, compassionate, and ethically grounded individuals. Islamic education emphasizes virtues such as *amanah*, *'adl*, and *ihsan* (Nata, 2012; Arifin, 2017; Azra, 2015), while Christian education highlights love, service, and Christ-like character as core expressions of learning (Van Brummelen, 2009; Smith & Smith, 2011). Although articulated through different theological frameworks, both traditions place moral purpose and character development at the center of the educational experience—an emphasis consistent with broader research on deeper learning and whole-person development (Darling-Hammond *et al*., 2020).

A second area of alignment lies in the understanding that meaningful learning connects knowledge with real-life contexts and social responsibility. Islamic thought frames this connection through the integration of *iman* and *ilm* and the principle of *ilmu–amal*, where knowledge is enacted through ethical action and service to others (Azra, 2015; Saukah, 2025). Christian education similarly maintains that learning is meaningful when it leads students to serve others with love, responsibility, and humility (Oppewal, 2016; Prabhu Das, 2021). Both perspectives affirm that meaningful learning extends beyond cognitive mastery to include moral agency and contribution to the common good.

Third, both traditions associate joyful learning with relational, caring, and emotionally safe environments. Islamic educational practice emphasizes rahmah, empathy, and the nurturing guidance of the *murabbi*, a teacher who cultivates trust and encourages curiosity without fear (Saukah, 2025). Christian scholarship likewise emphasizes classrooms as communities of care in which students feel valued, supported, and able to engage in learning with gratitude and wonder (Goodson, 2014). Across both contexts, joy is understood not as entertainment but as a natural outcome of belonging, engagement, and meaningful participation.

Ultimately, Islam and Christianity share the view that education aims to achieve holistic transformation, encompassing the intellectual, emotional, moral, and spiritual

dimensions of the learner. Islamic models describe this through ethical maturity and inner cultivation (Arifin, 2017), while Christian perspectives frame it as the formation of mind, heart, and action directed toward the flourishing of others (Randall, 2003). These shared commitments provide a strong foundation for implementing Deep Learning principles in faith-based schools, demonstrating that meaningful and joyful learning is highly compatible with value-driven education across both traditions.

3.3.2. Complementary Emphases in Islamic and Christian Perspectives

Although Islamic and Christian perspectives share many standard foundations, each carries its own emphasis that enhances and complements the other.

In Islamic education, meaningful learning is closely connected to moral discipline and the unity of faith and knowledge. Students are encouraged to view learning as an *amanah*, a trust from God, in which knowledge must be put into practice through ethical conduct and social responsibility (*ilmu–amal*). Values such as *amanah*, '*adl*, and *ihsan* shape how learners understand meaning, while joyful learning grows from *rahmah*, empathy, and the nurturing role of the *murabbi* who guides students with gentleness and moral clarity (Nata, 2012; Arifin, 2017; Azra, 2015; Saukah, 2025).

Christian education provides a complementary emphasis by focusing on identity, relationships, and calling. Meaningful learning is understood as helping students recognize their God-given call and use their knowledge and gifts to serve others with love and integrity. This perspective emphasizes the development of wisdom, purpose, and Christ-like character as key outcomes of learning (Van Brummelen, 2009; Smith & Smith, 2011). Joyful learning is associated with a caring community in which students feel safe, valued, and supported. It is an atmosphere that nurtures curiosity, gratitude, and wonder toward God's creation (Goodson, 2014). This relational approach encourages students to engage in learning with hope and to see their growth as part of a larger calling to contribute to the flourishing of others (Oppewal, 2016; Prabhu Das, 2021).

Together, these emphases offer complementary strengths for faith-based Deep Learning. Islamic perspectives offer a robust moral and ethical foundation, along with a disciplined approach to knowledge as a responsibility. In contrast, Christian perspectives emphasize relational care, personal purpose, and reflective growth. When viewed side by side, these distinct emphases complement and expand the possibilities for supporting meaningful and joyful learning in diverse faith-based educational contexts.

3.3.3. Implications for Deep Learning in Faith-Based Schools

The comparison between Islamic and Christian perspectives reveals that both offer a robust foundation for implementing Deep Learning in faith-based schools. Their shared focus on faith, character, and responsibility supports the view that meaningful

and joyful learning can emerge from values already present in each educational context. This alignment indicates that schools need not abandon their identity to adopt Deep Learning; instead, the framework naturally aligns with the moral and spiritual aims of both perspectives.

The differences in emphasis also offer practical insights. The Islamic perspective, with its focus on *amanah*, *'adl*, *ihsan*, and the unity of faith and knowledge, can reinforce the "meaningful" dimension of Deep Learning by encouraging students to see learning as a responsibility that should lead to ethical action and social contribution. Meanwhile, the Christian perspective, which emphasizes identity, relationships, and personal purpose, enhances the "joyful" dimension by fostering classrooms that are caring, reflective, and supportive, which describe conditions that help students feel safe, valued, and engaged.

These insights suggest that faith-based schools can integrate Deep Learning in ways that are morally grounded, relationally supportive, and spiritually meaningful. Islamic perspectives clarify ethical responsibility and disciplined character, while Christian perspectives enrich learning through relational care, reflection, and a sense of purpose. These complementary strengths are especially relevant in the digital era, where students must learn to navigate information critically while grounding their decisions in clear ethical and spiritual values. These findings directly address the study's objective of examining how Deep Learning is interpreted and enacted through religious values in faith-based high schools.

3.4. Implementation in Schools

3.4.1. Implementation in SMA Muhammadiyah 1 Yogyakarta

SMA Muhammadiyah 1 Yogyakarta integrates meaningful and joyful learning through project-based, value-oriented practices that connect Islamic character formation with contemporary pedagogy. The school's commitment to *iman–ilmu–amal* shapes the design of learning experiences, where academic competencies are accompanied by indicators of *amanah*, *'adl*, and *ihsan*. These values guide teachers in designing lessons that deepen students' conceptual understanding and encourage responsible application of knowledge.

Meaningful learning is developed through inquiry-based and discovery-based strategies that incorporate Islamic reflective practices such as *tafakkur* and *tadabbur*. Teachers guide students to examine concepts not merely through memorization, but through understanding relationships, causes, and implications. These approaches are crucial in the digital era, where students must navigate vast amounts of information and develop a moral foundation, critical thinking, and responsible social behavior. Lessons are consistently contextualized through real-life issues in Yogyakarta, such as environmental conservation, local culture, social dynamics, and creative

entrepreneurship, thereby enabling students to view knowledge as a tool for *amal shalih* and meaningful social contribution. Interdisciplinary project-based learning is a central feature in which subjects such as science, social studies, history, and the arts are combined with Islamic values to create integrated and authentic tasks.

Assessment practices support this approach by reducing task overload and integrating evaluation across subjects. Students are assessed through portfolios, project outputs, reflections, and performance tasks that capture both cognitive progress and the demonstration of values such as responsibility, collaboration, and fairness. This authentic assessment model emphasizes process, reasoning, and contribution rather than isolated test scores.

Joyful learning is cultivated through a relational, humanizing classroom atmosphere shaped by *rahmah*. Teachers act as *murabbi*, who are mentors who guide with empathy, patience, and respect. Classrooms are structured to be dialogic and inclusive, employing open discussions, healthy humor, and appreciation of student participation to foster confidence and emotional safety. Students are encouraged to take ownership of their projects, engage in self-assessment, and develop creativity and independence under the guidance of supportive instructors.

Through these practices, SMA Muhammadiyah 1 Yogyakarta demonstrates how Islamic values can strengthen the goals of Deep Learning. By integrating ethical character, contextual relevance, interdisciplinary inquiry, and a caring classroom environment, the school fosters learning that is conceptually rich, socially meaningful, spiritually grounded, and emotionally engaging.

3.4.2 Implementation in SMA IPH Surabaya

Implementation of meaningful and joyful learning at SMA IPH Surabaya is guided by the school's mission and Graduate Profile, which integrates academic competencies with character formation, critical thinking, collaboration, and responsible citizenship. These practices are increasingly relevant in the digital era, where students need discernment, collaboration, and reflective habits to engage information responsibly. Teachers design learning so that students understand the purpose of each lesson and can connect new concepts with real-life contexts.

Meaningful learning is fostered through active learning practices, in which students deepen understanding through questioning, guided exploration, discussion, and collaborative problem-solving. Teachers clarify learning goals at the beginning of the lesson, then support students as they analyse ideas, test assumptions, and apply concepts in different contexts. A practical example is the Science Club, where students design simple bridge models, test their stability, revise their designs, and reflect on the process. This activity strengthens critical thinking, perseverance, and teamwork, while

providing students with the satisfaction of solving real-world problems through hands-on exploration and experimentation.

Joyful learning is nurtured in a positive and caring classroom atmosphere, where teachers demonstrate patience, empathy, and encouragement. Students are given space to express ideas, take risks, and collaborate without fear of failure. Programs such as the Student-Led Conference (SLC), internships, and leadership roles in the Student Council (OSIS) promote student agency, helping learners take ownership of their progress.

A second example of meaningful and joyful learning is *IPH for Humanity*, a Grade 12 service-learning initiative. Students collaborate to identify community needs, plan fundraising strategies, and implement support projects. The process is interdisciplinary, linking subjects such as Mathematics, Religious Studies, and Economics, while also developing communication, leadership, and teamwork skills. Through this experience, students develop empathy, a sense of responsibility, and a sense of purpose as they witness the tangible impact of their efforts on the community.

Assessment practices emphasize learning as a continuous, reflective process. Teachers use questioning, formative checks, feedback conversations, and peer or self-assessment routines to monitor progress and guide improvement. Portfolios, presentations, and project outcomes complement summative tests, providing a broader picture of how students develop in knowledge, skills, and character.

Overall, SMA IPH Surabaya demonstrates how meaningful and joyful learning can be strengthened through active engagement, relational care, reflective practice, and authentic service experiences, supporting a deeper understanding and preparing students to contribute responsibly to their communities.

3.5. Integrative Discussion

The analysis of both schools demonstrates that meaningful and joyful learning can be strengthened when pedagogical practices are aligned with the spiritual values and educational missions of faith-based institutions. These findings resonate with the broader Deep Learning literature, which emphasizes engagement, purpose, student agency, and whole-person development as central to responsible learning in contemporary contexts (Fullan & Quinn, 2018; Darling-Hammond *et al.*, 2020). In this sense, religious values do not stand in opposition to Deep Learning; instead, they provide a moral and spiritual grounding that deepens its educational intent.

Across both cases, several consistent patterns emerge. First, meaningful learning is fostered when students connect classroom concepts to real-life experiences and social responsibilities, aligning with Deep Learning principles that view learning as purposeful beyond academic achievement. Second, joyful learning is sustained through relational care, emotionally safe environments, and opportunities for reflection,

supporting students' sense of belonging, agency, and intrinsic motivation. These findings reinforce the view that joy in learning is not merely affective but emerges from meaningful engagement, recognition, and contribution.

At the same time, the findings highlight essential strengths and challenges in implementing Deep Learning within faith-based contexts. A key strength lies in the clarity of moral direction provided by religious values, which supports character formation, ethical discernment, and a sense of purpose in learning. However, the interpretation and enactment of Deep Learning remain highly context-dependent, shaped by school culture, teacher capacity, and institutional vision. This suggests that while faith-based values can strengthen Deep Learning, such approaches require reflective pedagogical leadership and sustained professional development to avoid superficial adoption.

The school practices examined in this study illustrate context-sensitive ways of implementing Deep Learning principles. Project-based and inquiry-driven learning, reflective classroom practices, service-learning initiatives, and relational school cultures function as practical expressions of meaningful and joyful learning. These practices demonstrate how Deep Learning can be enacted not as a standardized model, but as an adaptive framework shaped by local values, community needs, and educational purposes.

Taken together, these findings directly address the study's objective of examining how Deep Learning is interpreted and enacted through religious values in faith-based secondary schools. The analysis suggests that Islamic and Christian perspectives offer complementary contributions to Deep Learning by grounding learning in ethical responsibility, relational care, and purposeful engagement. Within Indonesia's plural educational landscape, such integrations offer promising pathways for strengthening Deep Learning in ways that are morally grounded, contextually responsive, and educationally meaningful.

4. CONCLUSION AND IMPLICATIONS

This study demonstrates that the principles of Deep Learning can be meaningfully strengthened by integrating religious values into faith-based education. By examining Islamic and Christian educational perspectives, the study shows that meaningful and joyful learning is deeply connected to reflection, moral responsibility, relational care, and purposeful engagement. The findings confirm that faith-based schools need not separate spiritual formation from contemporary pedagogical innovation; instead, Deep Learning can be interpreted and enacted in ways that are ethically grounded, relationally supportive, and contextually relevant.

From a theoretical perspective, this study contributes to the growing discourse on Deep Learning by extending its scope beyond cognitive and pedagogical dimensions to

encompass moral and spiritual interpretation. By situating Deep Learning within Islamic and Christian educational frameworks, the study highlights how spiritual values shape the meaning of learning, joy, and responsibility, offering a value-driven lens that enriches existing models of whole-person and deeper learning.

In terms of educational practice, faith-based schools can operationalize Deep Learning through reflective pedagogy, contextualized learning, and service-oriented experiences that align with their religious identity. The cases examined demonstrate that practices such as inquiry-based learning, relational classroom environments, authentic assessment, and service learning support both academic growth and character formation. These practices provide practical insights for educators seeking to implement meaningful and joyful learning without compromising faith commitments.

At the policy level, this study supports the relevance of the Indonesian Deep Learning framework by illustrating how its principles can be contextualized within faith-based schooling. The findings suggest that national educational policy can be strengthened by recognizing religious values as legitimate resources for fostering ethical awareness, empathy, and responsible citizenship, particularly in the digital era. This alignment reinforces the inclusivity of Deep Learning within Indonesia's plural educational landscape.

Finally, future research may extend this study by incorporating empirical classroom observations or interviews to deepen the understanding of how meaningful and joyful students and teachers across diverse faith-based contexts experience learning.

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Development Of MVPB Media to Improve Writing Skills In English Subjects for Phase C Students

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ABSTRACT

English learning is much more difficult than Indonesian learning due to differences in pronunciation and writing. This research is motivated by writing errors in English subjects such as the lack of letters in a vocabulary, the use of capital letters, and punctuation according to writing rules. One alternative to support learning regarding writing skills is the use of media that focuses on writing. Therefore, the purpose of this study is to develop media that can support English learning, especially to improve writing skills. The type of research applied is using the 4-D model or Define, Design, Develop, and Disseminate and data acquisition through validation by material experts, linguists, media experts, and learning experts. The results obtained from the material expert validator were 100%, linguists validation was 97.43%, media validation was 92.42%, and learning experts validation was 81.81%. The improvement in students' writing skills obtained an average gain score of 0.4 which is categorized as moderate. Therefore, the use of MVPB media has implications for improving writing skills in elementary school English subjects phase C.

Keywords: *Elementary School, English, Learning Media,Writing Skills.*

1. INTRODUCTION

Language is the primary tool for communicating with others. It is a tool for conveying expressions, feelings, and ideas from the communicator to the recipient. Language skills are the basis for everyone to express themselves, starting from their feelings, desires, opinions, and needs as individuals (Akmalia et al., 2022). One of the languages that can be used is English, after Indonesian as the mother tongue of Indonesian citizens. English is an international language used for communication in various fields of life.

In today's era of globalization, which is saturated with digital technology, the use of English as a means of communication has become a necessity for all groups, both children and adults who use English in various fields such as online games, education, business, trade, politics, tourism, and other fields (Sari, 2022). To be able to compete internationally, mastery of English is needed as a means of communication to convey messages, ideas, thoughts, and intentions to others. Speaking of English, English is one of the languages studied around the world because it is an international language that covers all aspects of global life, whether for children, student exchanges to overseas universities, entrepreneurs, large traders, or high-ranking officials (Arnesti & Hamid, 2015).

Learning English is much more difficult than learning Indonesian, but understanding the meaning of the language itself, students must also be able to pronounce and write words or sentences in English according to the rules of English writing. This difficulty sometimes makes students or children's interest in learning English very low (Akmalia et al., 2022). This is also because English is not a compulsory subject, so the inclusion of English in the school curriculum is a decision made by the school. Various requirements, such as teaching modules, methods, teacher development, and media, are prepared by the school itself.

The objectives of English language subjects are based on the Decree of the Head of the Curriculum Standards and Education Assessment Agency of the Ministry of Education, Culture, Research, and Technology Number 032/H/KR/2024 concerning Learning Outcomes in Early Childhood Education, Primary Education, and Secondary Education Levels in the Merdeka Curriculum are to develop communicative competence in English through various multimodal texts (oral, written, visual, and audiovisual); as well as to develop critical and creative reasoning skills.

Writing skills in English language learning in elementary school are an important part of communication needs in life. English is not only communicated orally, but can also be in writing because it can accommodate more ideas and impressions if we know and apply the right writing techniques because it can hone vocabulary, grammar, and pronunciation skills (Pantau, 2017). Writing is an activity carried out to communicate by arranging, recording, and stringing together letters through the process of communicating the meaning of the writing so that it becomes a sentence that provides information to achieve a specific purpose (Purnama et al., 2016).

Based on the results of interviews and observations, there are still students who make mistakes in writing vocabulary, as mentioned by the teacher. For example, for “a long dress,” students will take the flashcard with the corresponding picture and then rewrite it as “a long dres.” This shows that students understand the meaning of the vocabulary but make minor mistakes in writing. The spelling errors in question are missing letters in a word, incorrect use of capital letters, and incorrect punctuation according to the rules of writing. Errors in a simple sentence must be corrected immediately so that subsequent writing will minimize or even eliminate the same errors.

In this learning process, teachers use flashcards as a learning medium. Flashcards contain pictures, and students are instructed to write the pictures in English and write them in a simple sentence according to the teacher's dictation. The role of media in learning is to help students understand the content of the material being taught. With the help of media, teaching and learning activities can be made more interesting and interactive, creating a pleasant learning atmosphere. The media used in learning can be in the form of print, audio, audio-visual, interactive multimedia, or e-learning. The learning media that is widely used, especially in English lessons, is flashcards.

Flashcards have been proven to increase scores by 44% after using the flashcard image learning method (Iswari, 2017).

The use of flashcards has been widely applied by teachers in learning. Based on research by Nurafiani & Iftidiani, 2023, entitled Analysis of English Language Learning Through Writing and Reading Skills Using Picture Books and Texts in Elementary Schools (Language Learning Journal), the use of picture books and texts in English language learning at the elementary school level can improve students' English reading and writing skills. This shows that integrating picture books into the curriculum can significantly support language development. Meanwhile, research conducted by Hesti & Nuryanti, 2022, entitled "The Effectiveness of Flashcards on Elementary School Students' English Vocabulary Writing Skills" found that the use of flashcards can improve English vocabulary writing skills with a negative t-value of -7.135. This negative t-value indicates a difference between the pretest and posttest, as well as a significant increase in scores.

Based on the background described above, in order to improve students' writing skills in English, the development of appropriate learning media is very important. By utilizing technology and various types of media inspiration, the learning process can be made more interesting and effective. Combining the concepts of flashcards and dictation as used in learning, the researchers developed a printed medium in the form of a book so that the pictures and writing remain in the same place. According to Yulia in (Harahap dkk., 2022), print learning media is media that comes from text, images, and other supporting illustrations used as a means of conveying learning information.

2. METHODOLOGY

This study uses the Design and Development (D&D) method with a focus on product and tool development. In their paper, (Richey & Klein, 2014) explain that product studies focus on the design and development of instructions or non-instructional principles that are relevant to practitioners. The research model used in this study to achieve product development results is 4-D or Define, Design, Develop, and Disseminate. So, this research uses the D&D approach with 4-D stages. In (Thiagarajan dkk., 1976), the stage categorized as "define" is described as an analytical stage and involves five steps: preliminary analysis (problems faced by teacher trainers), learner analysis, task analysis, concept analysis, and determination of instructional objectives. The next stage is design, or the design of instructional material prototypes, which consists of four steps: creating tests based on criteria, selecting media, selecting formats, and initial design for the presentation of instruction through media such as tests, textbooks, audio tutorial models, and computer-assisted instruction. The development stage consists of modifying the prototype material through expert assessment and development trials. For the final stage (disseminate), it is explained

that there is a summative evaluation, final packaging activities such as copyright management, and dissemination.

2.1 Data collection techniques

The data collection methods used in this study were interviews, observations, questionnaires, and tests. In the interview stage, the researcher conducted open interviews with phase C English teachers. The interviews were conducted to obtain answers that were relevant to the research needs. During the observation stage, the researcher observed elementary schools to see and learn firsthand about the conditions of phase C students and to gain a general understanding of their writing skills in English. The interview and observation stages were conducted to provide the researcher with real data to adjust the development or research based on empirical evidence from literature reviews, student conditions, and the school environment. Questionnaires were used to determine the feasibility of the media developed by the researcher through validation by media experts, subject matter experts, language experts, and learning experts. The study used a One Group Pretest-Posttest Design to test the MVPB learning media developed to improve the writing skills of fifth-grade students.

2.2 Research Instruments

Based on the above research techniques, there are guidelines for conducting research or collecting data, including guidelines for research techniques using interview instruments, observation sheets, questionnaires, and test questions. Several types of instruments were used. Interviews were conducted to gather information about the curriculum, teaching and learning activities, media, strategies, and evaluation. Observations were used to directly observe the learning process and the use of instructional media. Questionnaires were administered to obtain data on materials, language, media, and learning. Meanwhile, tests were used to assess writing neatness, word choice, spelling, punctuation accuracy, and creativity.

2.3 Data analysis techniques

In this study, quantitative data analysis was obtained from media feasibility questionnaires that had been assessed by validators and to compare the results of pretest and posttest activities. Quantitative data analysis was obtained from the results of questionnaire analysis. The questionnaires were analyzed using a Likert scale. This study used a 4-point even Likert scale, namely three, two, one, and zero. According to Hadi in Hariawan (2019), using a four-point Likert scale is intended to eliminate the weaknesses contained in odd or five-point scales, such as double meaning (undecided) and central tendency effect.

Table 1. Likert Scale Score Category

Skor	Category
0	Need Guidance
1	Enough
2	Good (Decent)
3	Very Good (Proficient)

The improvement in students' writing skills was analyzed using statistical techniques with normalized gain score analysis (Hake in Mufida & Qosyim, 2020) with the following calculations:

$$g = \frac{Posttest\ Score - Pretest\ Score}{Maximal\ Score - Pretetst\ Score}$$

The sum of the scores obtained from each aspect will reflect the quality of the students' writing skills in accordance with the indicators determined through the developed MVPB media. Then, the gain score obtained is interpreted (Wahab et al., 2021) according to the following criteria:

Table 2. N-Gain Criterion

Range *N-Gain*	N-Gain Criterion
g > 0,7	High
0,3 ≤ g ≤ 0,7	Medium
0 < g < 0,3	Low
g ≤ 0	Failure

Qualitative data will be managed using the Miles and Huberman technique. According to Miles and Huberman in (Zulfirman, 2022), interactive model data analysis consists of three main components, namely data reduction, data presentation, and conclusion drawing or verification. Data reduction involves selecting and simplifying relevant data, data presentation organizes information in an easily understandable form, while drawing conclusions or verification is the process of drawing conclusions and verifying their accuracy based on the analyzed data.

3. RESULT AND DISCUSSION

Media MVPB Design

The first stage in the development of the My Vocabulary Pocket Book (MVPB) learning media was the definition stage. After the definition stage, the next stage was the design stage. In the definition stage, the researcher conducted a beginning-end analysis, learner analysis, task analysis, and learning objective design. The first step taken by the researcher was to identify the problem. The problem identification activity was carried out at an elementary school in Parongpong, West Bandung Regency. Problem identification was carried out through observation and interviews with English teachers in phase C, especially those teaching fifth grade. Based on the results of the

observation and interviews, it was found that there was a need to strengthen the language skills of students, namely writing and listening skills, in the fifth grade for the 2024/2025 academic year. Students already knew vocabulary related to clothing based on what they had previously learned in the 2021 independent curriculum package book from the Ministry of Education, Culture, Research, and Technology. Although students can write simple vocabulary and sentences in English as dictated by the teacher, there are errors in their writing, such as missing letters, for example, the word “dress” becomes “dres,” and incomplete punctuation

The learning process refers to the elements of the fifth grade English subject unit 5, namely, the elements of writing and presenting. In this element, students are expected to have the ability to produce language to convey and express ideas or messages. Based on this, the learning objectives are formulated, namely that students are able to identify and name the types of clothing worn by people.

The next step, after identification, is to design the media. The media is designed based on test criteria that will be included in the media, namely exercises and evaluations. Assessment is carried out on five indicators, namely writing skills, namely neatness of writing, choice of words, use of spelling, correct punctuation, and creativity in written language. Each aspect of the indicators has four assessment ranges with a score range of 0-3 and the highest category is excellent or proficient, good or adequate, sufficient, and the lowest category is needs guidance.

Media selection Based on the classification of learning media, MVPB is designed from the results of print technology in the form of books. The books are not large, so they are flexible for users. The size is 12×7cm. MVPB media is printed using art paper with glossy lamination and a hardcover. The format designed contains the material in unit 5 of grade 5 in the book published by the Ministry of Education, Culture, Research, and Technology in 2021, English Student Book for Elementary/Madrasah Ibtidaiyah Grade 5, written by the ELYC team. After determining the media and format, a preliminary design was made. The initial design of the MVPB media consists of 9 parts, namely: 2 cover pages, 1 Book Details page, 1 Objectives page, 1 How to Use This Book? page, 5 subheading pages, 5 Story pages, 8 exercise pages, 5 evaluation pages, and 4 glossary pages.

Validation Result of MVPB Media

The results of MVPB learning media development were obtained through two stages, namely the develop stage and the disseminate stage. The develop stage was carried out in two steps, namely expert validation and product testing. Expert validation was carried out by subject matter experts, language experts, and learning experts (subject teachers). Product testing was conducted on phase C elementary school students, particularly those in grade VI in the 2025/2026 academic year. To evaluate

the feasibility of the media produced, expert validation was carried out. Each expert received an instrument to evaluate the feasibility of the media. A questionnaire with data analysis using a Likert scale was used as a research instrument.

Table 3. MVPB Media Validation Results by Experts

No	Validator	Percentage Results	Category
1.	Materials Expert	100%	Very Worthy
2.	Linguist	97,43%	Very Worthy
3.	Media Expert	92,42%	Very Worthy
4.	Learning Expert	81,81%	Very Worthy

The next step after validation by experts is to conduct development trials. Development and product effectiveness trials will be conducted on all sixth-grade students in the 2025/2026 academic year. This aims to ensure that the device meets quality standards and can be used practically with the packaging process of learning materials so that it is easy to understand and attractive to users. This includes visual presentation and formats tailored to elementary school students. Next, the media is distributed to the audience. In this study, distribution was carried out through socialization, which included explanations of the concept, how to use it, and the purpose of the MVPB media. Socialization was carried out with 9 teachers, 2 prospective teachers, and 14 students.

MVPB Media Final Results

Based on the previous stages, the MVPB media has been adjusted according to the results of problem identification, format selection, media selection, initial design, and validation. The final result of the MVPB media uses several fonts that have been adjusted, namely Core Bandi, Dynapuff Condensed, Amaranth, Courgette, Mango AC, and Shrikhand as font variations. This book consists of several main sections. At the beginning, there are the front and back covers, which display information about the book's title. After that, there are Book Details, which outline the book's identity, followed by Objectives, which explain the learning objectives. The "How to Use This Book?" section provides instructions on how to use the book. Next, there are Subtitles, which explain the learning activities. The "Story" section presents the storyline, followed by Exercises, which contain practice questions related to the story. After that, the "Evaluation" section provides evaluation questions. At the end of the book, there is a Glossary containing important vocabulary that appears in the story.

MVPB Media to Improve Writing Skills

The results of student achievement in writing skills for each indicator show an increase and change in the average for each indicator through pre-tests and post-tests, which can be seen in the following graph:

Figure SEQ Figure* ARABIC 1. Diagram of Pretest and Posttest Result for Each Indicator

The results of the assessment based on each indicator were then calculated as the average overall pretest and posttest scores to see the improvement through gain score analysis. To see the improvement score, calculations were made using statistical techniques through normalized gain score analysis. All quantitative score calculations were made using Microsoft Excel 2019 software, one of the results of which is shown in Table 6 below:

Table 4. Pretest, Posttest, and N-Gain Scores of Students' Writing Skills

Average	*Pretest* Score	*Posttest* Score	Gain (g)	Information
	8,5	11,3	0,43	Medium

DISCUSSION

The MVPB media development design began with the first two stages of the 4-D research model, namely define and design. In the definition stage, the first step was for researchers to conduct a preliminary analysis with the aim of identifying problems in schools. The identification was carried out in one of the elementary schools in West Bandung Regency by conducting interviews and observations.

Referring to the interview results, it was conveyed that there are students who need reinforcement in language skills, especially writing and listening skills. The problems found from the observation and interview results are in line with the findings of Pratiwi & Hendratno (2024), which state that obstacles in the English learning process are related to the four language skills, namely listening, speaking, reading, and writing. These four skills often pose obstacles for students, such as when they write sentences according to the applicable writing formulas and rules. Utilizing learning media during the teaching and learning process is one effective strategy that can be applied to overcome the various needs and obstacles faced by students.

The learning media used by teachers, namely flashcards, are in line with the benefits of learning media according to Azhar Arsyad in (Karo-Karo & Rohani, 2015), namely, media can clarify the delivery of messages and information so that it can facilitate and improve the learning process and outcomes, increase and direct the

attention of students, thereby fostering motivation to learn, helping to overcome limitations, and providing experiences for students. The use of flashcards fulfills several functions of learning media classified by (Levie & Lentz dalam Mahmud, 2023), namely attracting students' interest during teaching and learning activities so that there is student involvement in learning activities, attracting students' interest in learning media, helping to facilitate students in learning activities, and helping students with limitations.

The design stage consists of three steps. The first step in the design stage is the development of criteria-based tests. This step is developed with reference to the learning objectives. Tests or evaluations are designed to assess writing skills and vocabulary mastery. The criteria are designed in accordance with writing skill indicators, namely neatness of writing, word choice, correct use of spelling and punctuation, and creativity in written language. According to Calengosi in Bhakti et al. (2015), tests are one of the planned measurement methods used by teachers to provide opportunities for students to demonstrate their achievements related to predetermined objectives.

The next step in the design stage is the selection of media and format. The selection of media is tailored to the characteristics and classification of the media being developed, namely printed media in the form of a pocket dictionary. The book media is designed to be compact so that it is flexible for users. The size used for the MVPB media is 12×7cm, which is adapted from the pocket dictionary created by Zhafira Aqyla, a content creator who focuses on education and sexual education and who also created a vocabulary book. The MVPB media is printed on art paper with glossy lamination and a hardcover. The use of art paper with glossy lamination allows the media to be reused because the ink can be erased if used with a marker. The media is designed with a hardcover to make it sturdy and durable. This media is a development of flashcards and dictionary books, so MVPB can be used anywhere and anytime. This is supported by (Nursyaida, 2016)'s findings that image media can help inspire students.

The final step in the design stage is to compile a preliminary design. The preliminary design is compiled based on the results of the analysis and previous design steps. The preliminary design consists of nine parts of the media, namely the cover page, book identification information page, learning objectives information page, media usage guide information page, subheading page, story page, exercise page, evaluation page, and glossary page.

The results of the MVPB learning media development validation were obtained through two stages, namely the develop stage and the disseminate stage. The develop stage consisted of two steps, namely expert validation and product testing. The expert validation step was carried out by four validators consisting of subject matter experts, language experts, media experts, and learning experts. The experts who carried out the validation came from their respective fields. Material and language validation was

carried out by a lecturer from the English Education study program, media validation was carried out by a lecturer from the Elementary School Teacher Education study program, and learning validation was carried out by a phase C English subject teacher.

Validation was conducted to determine the suitability of the media produced. Each expert received a tool to evaluate the suitability of the media. A questionnaire was used as a research tool with Likert scale data analysis. This study used an even 4-point Likert scale, namely three, two, one, and zero. According to Hadi in Hariawan (2019), using a four-point Likert scale is intended to eliminate the weaknesses of an odd or five-point scale, such as responses in the middle (central tendency effect) and double meanings (uncertainty).

The validation of the material is intended to provide an assessment of the suitability of the material created in the media and its relevance to the objectives of the English language subject. The final assessment of the suitability of the material received a score of 100%, which is categorized as “Very Suitable.” Before the final assessment, the validator provided several suggestions on the material in the MVPB media, namely to add a brief explanation of the reasons for wearing certain clothes. This aims to provide students with the opportunity to think at a higher level in the C4-C6 range of Bloom's taxonomy. Based on the revised Bloom's taxonomy, the content presented in the MVPB media was added to the cognitive domain of “Evaluating” with one of the keywords used being “Assessing” (Nafiati, 2021). The validation of language use was aimed at assessing the appropriateness of the language used in the media and its conformity with English language rules. The final assessment of the appropriateness of language use resulted in a score of 97.43%, which was categorized as “Very Appropriate”. The validation of the media was aimed at assessing the feasibility of the media development product created by adjusting the feasibility criteria in media creation, such as the aspects of organization, format, content, consistency, and attractiveness of each indicator. The assessment of media feasibility resulted in a score of 92.42%, which is categorized as “Very Feasible”. The validator provided several suggestions for the MVPB media, namely to add appropriate illustrations to the subheading pages. Therefore, the researcher added appropriate illustrations to the pages “Let's Read the Story!”, “Let's Do the Exercises!”, and “Let's Do the Evaluation!”.

The validation of media used in the learning process is intended to assess the suitability of the media development product in terms of media usage and content. The media suitability assessment resulted in a score of 81.81%, which is categorized as “Very Suitable.” The media was not only assessed by learning experts; the validators also provided suggestions to MVPB regarding the use of language. The English used in the MVPB text is not the kind of language that students encounter in their daily lives. It would be better to use language that is easy for students in phase C to understand, in line with the content and achievements outlined in the Merdeka curriculum package.

The media has been validated by expert validators in each aspect and improvements have been made based on their suggestions and input. This is in line with what Sukmadinata (2013) wrote, that if a product is proven to be invalid or less valid when tested by experts, the testing will be redone to ensure the results are as expected (Zamsiswaya et al., 2024). Therefore, based on the calculation results, the media is suitable for testing. The product testing phase was conducted on all phase C students, particularly sixth graders in the 2025/2026 academic year at one of the elementary schools in West Bandung Regency.

Learning tools will be considered effective if the learning objectives set can be achieved based on certain criteria (Situmorang & Simanullang, 2022). The MVPB media developed in this study focuses on students' writing skills in English phase C. Based on the results of trials and validation by four experts, MVPB media is suitable and effective for use in the learning process.

The disseminate stage is the final stage of the 4-D research model conducted in this product development process. This stage consists of three steps, namely product effectiveness testing, packaging, and product distribution to the public. The first step of the dissemination stage is validation testing or testing the effectiveness of the product in the field. This aims to ensure that the product meets quality standards and can be used practically. This step was carried out directly at an elementary school located in West Bandung Regency. Product effectiveness testing uses a One Group Pretest-Posttest Design, with the media used as treatment before the Posttest is conducted. The media product that has been tested until completion in the final stage of the 4-D research model is disseminated to a limited audience at one school, specifically sixth grade students and subject teachers who are the research subjects, namely a private school located in West Bandung Regency. The product was distributed at the school where the research was conducted to school teachers, students, and prospective teachers by observing how the media was used in the learning process during the trial. Distribution was also carried out by socializing the introduction of the media, the concept and objectives of MVPB, and how to use it in learning.

MVPB media uses several fonts, including *Core Bandi*, *Dynapuff Condensed*, *Amaranth*, *Courgette*, *Mango AC*, and *Shrikhand*. Not all fonts are used on a single page; rather, they are adjusted according to need. The Core Bandi font is used for the title on the cover page, the Dynapuff Condensed font is used for the titles needed on each page and for the page numbers, the Amaranth font is used for writing questions or texts on each page, the *Courgette* font is used on the subheading and story title pages, the Mango AC font on MVPB media is used for numbers on practice and evaluation questions, and the *Shrikhand* font is used for pages with questions in the summer clothes category for random letters.

The background used in MVPB media is vertical and horizontal lines in pink; brown; blue; yellow, winter atmosphere, summer atmosphere, sports equipment, and Pastel Gray Orange colors. The background is determined by the themes on the page, for the winter clothes category it is adjusted to the winter atmosphere, the summer clothes category is adjusted to the summer atmosphere, and the sportswear category is adjusted to the background of several sports equipment.

The My Vocabulary Pocket Book learning media or hereinafter abbreviated as MVPB has been tested for implementation to determine the improvement in the writing skills of phase C students. Learning outcomes based on the textbooks used in the learning and teaching process, clothing material was found in class V, but implementation activities were carried out in class VI because students had entered the next academic year.

The increase in the average score of all indicators from 1.7 to 2.3 indicates that there is quite good development in students' writing skills after the intervention or learning carried out. MVPB media is proven to improve students' writing skills. This is in line with the results of research conducted by (Permata & Indihadi, 2025) that the use of media with visual images (daily journals) can encourage students' imagination so that they can enrich the content of their writing and can improve writing skills continuously through students' personal experiences. This research is in line with MVPB media that can be used continuously, although in this study, the media was used in one learning session, MVPB media has shown an increase in indicators of written language creativity where there are arguments, ideas, or students' imagination in writing.

Indicators of neatness of writing and the use of correct punctuation also increased. In MVPB media, there are exercises and evaluations that provide students with the correct learning experience by writing on the straight lines provided. According to (Jamaludin et al., 2023), by applying the exercise method, the frequency of students' writing becomes more frequent, so they are accustomed and more practiced in writing. The results obtained from their research indicate that the use of image media in learning has a positive impact on students' writing skills. In cycle 2, classical completeness exceeded the established KKM (Minimum Completeness Criteria) (>80%), this achievement was influenced by improvements in several factors, one of which was writing sentences correctly and neatly. In addition, students can write objects completely and clearly by composing writing through good grammar and using correct punctuation and spelling (Jamilah et al., 2023).

Based on Table 6, there are 7 students in the low category, 5 students in the medium category, and 2 students in the high category. The overall average N-Gain result of students' writing skills is 0.43. The average N-Gain obtained shows that it is in the medium criteria. This shows that in general, the use of MVPB media has a

sufficient influence on improving students' writing skills, although the variation in the level of improvement between individuals is quite diverse.

Learning media according to Levie and Lentz in Nasron et al., 2024, has four main functions, namely attracting students' attention (attention function), arousing students' emotions and attitudes (affective function), facilitating understanding and remembering information (cognitive function), and facilitating students who are weak and slow to receive information (compensatory function). Based on this statement, the use of MVPB media through a series of learning students feel happy during learning with MVPB media, in addition students also try to be able to answer the questions in the media, both practice and evaluation. MVPB media is equipped with a glossary so that it makes it easier for students when they have difficulty with new vocabulary, facilitates understanding, and remembers information.

4. CONCLUSION

The media developed through four stages: identification or definition, design, development, and dissemination received a "Very Adequate" result based on an assessment by experts including material experts, language experts, media experts, and learning experts. The media was used and tested to measure the improvement of students' writing skills. The indicators used consisted of five, including neatness of writing, word choice, spelling, correct punctuation, and written language creativity. These five indicators showed improvement, especially the written language creativity indicator which experienced a significant increase compared to the other indicators.

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Reconceptualizing Disaster Resilience in Early Childhood Education: A Systematic Review of ICT-Mediated Curricula Trends (2013-2023)

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ABSTRACT

Disasters can have a significant impact on children's well-being, making it important to effectively educate them on risk mitigation and potential hazards. This research aims to reveal the scope of research on the topic of ICT Media-Based Disaster Curriculum from 2013 to 2023. This research systematically analyses the research content on Disaster Curriculum through ICT media. A systematic review was conducted using the Systematic Review and Meta-Analysis (PRISMA) procedure. The results of article searches conducted through Google Scholar Search using the Publish or Perish 8 application with various related keywords found 810 papers in the period 2013 to 2023. From the screening and eligibility results, 11 articles were included. From the analysis results, 9 articles have different country distributions in each article. Meanwhile, according to the year of publication, research related to the ICT Media-Based disaster curriculum has decreased every year. The results showed that although the publication of ICT Media-Based Resilience Curriculum articles distributed in journals is very diverse, the existence of research on the topic of ICT Media-Based Resilience Curriculum from 2013 to 2023 has decreased so further research is needed to improve the topic again.

Keywords: *Disaster Curriculum, Early Childhood Education, ICT Media*.

1. INTRODUCTION

In the contemporary landscape of early childhood education (ECE), the development of disaster-related curricula increasingly relies on advanced data representation, such as density visualization, to identify core thematic priorities. Density visualization serves as a foundational instrument for mapping educational content, enabling policymakers and curriculum designers to move beyond superficial instructional models toward data-driven decision-making (Haleem et al., 2022). By identifying areas of high conceptual density, educators can pinpoint critical themes that require intensified focus, ensuring that curriculum development addresses the most applicable risks for young learners (Zosh & al., 2022). This visualization not only clarifies the hierarchy of priorities but also reveals the intricate interconnections—and gaps—between disparate elements within disaster pedagogy. Consequently, it allows for the design of a coherent, intertwined structure where complex disaster concepts are synthesized into meaningful learning experiences (Borg & Samuelsson, 2022).

Furthermore, the shift toward visualization-supported frameworks optimizes student learning by transforming dense, complex data into interpretable trends and patterns. Recent scholarship emphasizes that meaningful disaster literacy in early

childhood is achieved when learning experiences are focused and contextually relevant (Trott, 2022). Networking and conceptual density mapping facilitate this by making disaster-related knowledge accessible, thereby helping children develop deeper cognitive understanding and practical skills. This approach also enhances transparency and communication among stakeholders, including educators, caregivers, and institutional partners, providing a shared visual language to discuss curriculum focus and collaborative goals (Elliott et al., 2024).

Moreover, a visualization-centric approach fosters an adaptive pedagogical stance. Given the rapid evolution of technology and the shifting nature of global environmental risks, curriculum inventors must remain responsive to the latest requirements (Biesta, 2022). Density visualization aids this agility, allowing for continuous monitoring and evaluation of a curriculum's effectiveness and its measurable impact on students. By tracking the density of specific instructional elements, designers can estimate the extent to which a program achieves its desired literacy objectives, ensuring that the curriculum remains a robust tool for developing children's capacities to respond effectively before, during, and after disaster events (Hattie & Donoghue, 2023).

This systematic review is grounded in an ontological framework that views disaster resilience not merely as a technical skill or a memorization of emergency protocols, but as a dynamic social reality constructed through interactive experiences (O'Grady, 2022)). In this study, ICT media is positioned as a transformative mediator that bridges the gap between abstract disaster concepts and a child's concrete understanding (Haleem et al., 2022). Unlike conventional methods that rely on passive rote-learning, ICT-mediated curricula allow children to simulate, visualize, and interact with complex environmental phenomena in a safe yet immersive digital environment (Zosh & al., 2022). This ontological stance asserts that a child's understanding of disaster risks is significantly shaped by the digital tools used to represent those risks, thereby making ICT an essential pedagogical 'lens' through which the reality of disaster mitigation is internalized and understood (Parker & Freathy, 2021; Schweitzer et al., 2022).

2. RESEARCH METHODS

This study employed a Systematic Literature Review (SLR) grounded in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement to ensure a rigorous, replicable, and transparent selection process. The SLR approach was chosen to synthesize fragmented evidence regarding digital pedagogy in disaster education, allowing for a comprehensive mapping of the current state-of-the-art (Brod, 2021). The methodology was systematically executed through four distinct phases: identification, screening, eligibility, and inclusion.

2.1 Search Strategy and Identification

The initial identification phase involved an extensive electronic database search via Google Scholar, facilitated by the Publish or Perish 8 application. This tool was utilized to maximize the harvest of metadata from diverse academic repositories, ensuring a broad multidisciplinary reach (Sahin, 2021). The search strategy employed specific Boolean operators and keywords: *"disaster curriculum"* AND *"early childhood education"* AND *"ICT media"*. To capture the most recent technological trajectories and "digital-native" pedagogical shifts, the search was limited to the decade between 2013 and 2023 (Mercer, 2019). This timeframe is critical as it encompasses the rapid digital transformation in ECE accelerated by global environmental crises. The initial search yielded a total of 810 records.

2.2 Screening and Eligibility Criteria

To refine the results, a two-stage screening process was implemented, adhering to high standards of methodological integrity (Hattie & Donoghue, 2023). In the first stage, duplicates and non-article records—including citations, book reviews, and papers with incomplete metadata were removed to maintain data purity, leaving 425 articles. In the second stage, titles and abstracts were rigorously screened based on predefined Inclusion and Exclusion Criteria to ensure the ontological relevance of the literature (O'Grady, 2022).

To ensure the objectivity of the selection process, specific eligibility criteria were established based on several parameters including time frame, document type, target population, and thematic relevance, as summarized in Table 1.

Table 1. Inclusion and Exclusion Criteria

No	Criterion	Inclusion Criteria (IC)	Exclusion Criteria (EC)
1	Time Period	Articles published between 2013 and 2023.	Articles published before 2013 or after 2023.
2	Document Type	Original research articles from peer-reviewed journals.	Book chapters, conference abstracts, editor notes, or citations only.
3	Target Population	Early Childhood Education (ECE) / Children aged 0–8 years.	Higher education, secondary education, or adult disaster management.
4	Core Topic	Integration of ICT-based media in disaster education/curriculum.	General disaster studies without ICT or curriculum focus.
5	Language	Full-text articles written in English or Indonesian.	Articles in languages other than English or Indonesian.
6	Accessibility	Open access or available full-text through institutional repositories.	Abstract only or restricted access (no full-text available).

2.3 Data Extraction and Inclusion

After applying the IC/EC, 38 full-text articles were assessed for eligibility. Articles were excluded if they only mentioned ICT peripherally without integrating it into the curriculum framework. This rigorous filtration resulted in **11 final articles** that strictly met all quality and thematic requirements.

2.4 Data Analysis (Thematic Coding)

The 11 included articles were analyzed using thematic synthesis. Data were extracted into a structured matrix covering: (a) year of publication, (b) geographic distribution, (c) type of ICT media used (e.g., augmented reality, digital games, video animation), and (d) pedagogical focus. This systematic approach ensured that the "ontological framework" mentioned earlier—where ICT mediates social reality—was consistently tracked across the selected literature.

3. RESULT AND DISCUSSION

Composition quests were carried out via the Publish or Perish operation which was limited to the period 2013 to 2023. A comprehensive hunt set up 810 papers from 3 keywords, for the first keyword, videlicet writing" disaster class", the alternate key was written" communication technology", the third keyword was "information technology", and the fourth keyword "early childhood education".

The study selection process is shown in the inflow illustration figure 1 as shown. This exploration uses the PRISMA (Preferred Reporting particulars for Methodical Reviews and Meta- Analyses) system. Journals were sourced from Scopus and Google Scholar, using the keywords" disaster class"," communication technology"," technology information", and" early nonage education" performing in 810 journals. To further upgrade it by filtering more specifically the disaster class so that the number becomes 9 journals. Next, 9 journals were screened and examined through Methodical Literature Review.

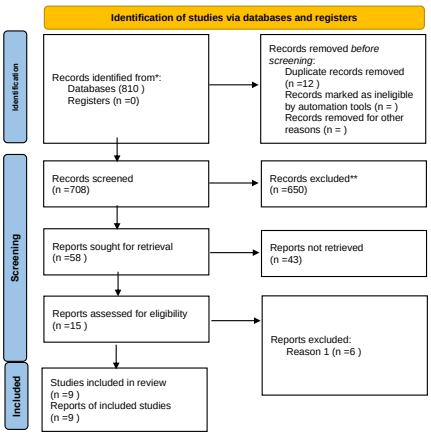

Figure 1. Flowchart explaining the process of selecting studies for inclusion

Disasters cannot be controlled, humans can only manage their impact or carry out mitigation. Through disaster mitigation and impact management, the risk of consequences will be reduced. One of the mitigation efforts is carried out through disaster education activities. This educational program is very necessary for everyone, especially people who are vulnerable to disasters. Groups that have quite high vulnerability include the elderly, children and people with special needs. This will greatly reduce the risks of injury, loss of life and psychological problems during and after a disaster.

Disaster education can be carried out through various programs, one of which is through disaster education in educational institutions. In order to implement this disaster education program, one very important instrument is needed, namely the curriculum. With good curriculum design, scope, sequence, continuity, integration, articulation and balance will be met (Hunkins, F. P., & Ornstein, 2018). The existence of a disaster curriculum is a program for students to understand and develop the skills needed to deal with disasters. The urgency of the disaster curriculum in its application goes beyond just providing theoretical knowledge of disasters, such as the meaning of disasters, types of disasters, names. More than that, the curriculum creates a guide for disaster education to train mental management, sensitivity, attitudes and problem solving when a disaster occurs or is affected.

In its implementation, the developing curriculum must keep pace with developments over time. This is based on the fact that we must educate children according to their era. Even at the beginning of preparing the curriculum, of course you have to consider contemporary aspects, that the curriculum speaks for now. In this era of rapid development of information technology, it is inevitable that in formulating the curriculum it takes into account aspects of information technology. For children technology may not provide a full sensory experience. The fear is that children will lose their creativity as they spend more time immersed in digital technology. Despite these concerns, many researchers believe that technology can improve certain skills. This helps the brain process new ideas quickly to improve reasoning and decision-making processes, thereby facilitating innovation.

Based on this, research is motivated to investigate trends in the development of disaster curricula in relation to the rapid development of communication technology and information technology. This research involved analysis of a total of 810 journals collected from trusted sources such as Scopus and Google Scholar. The selection process using the PRISMA method guarantees objectivity and transparency in selecting journals for further analysis. After undergoing the PRISMA stages. 9 journals were identified as worthy and relevant for further exploration. At this stage, the focus of the analysis is to compare the results of these journals, with the main aim of analyzing the

content of the disaster curriculum in children's education in relation to current communication technology and early information technology.

The findings from this analysis can be concluded that, although efforts have been made to compile and develop an ICT-based disaster curriculum, further improvements are still needed. Authors should understand the character and needs of early childhood, especially considering development from all aspects in a comprehensive manner. Through reviewing the results of this research, it is hoped that insight and input can be obtained which will help build the disaster curriculum at Early Childhood Education institutions as an important instrument in disaster education from an early age. This is an effort aimed at preparing children when a disaster occurs or is affected.

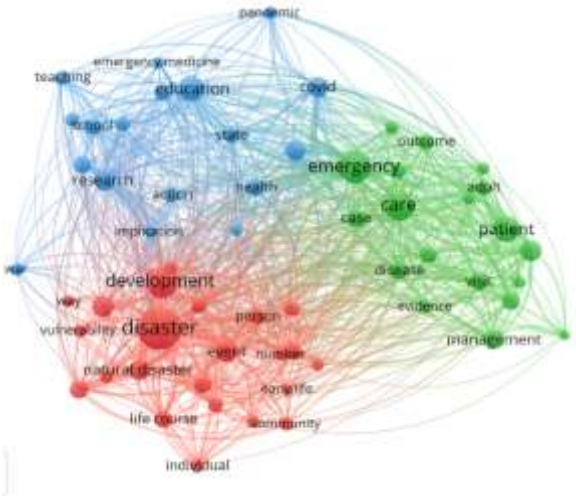

Figure 2. Network Visualization with VOSViewer

The use of the VOSviewer tool to analyze journals related to the disaster curriculum provides an interesting overview of this topic, especially in the context of Early Childhood Education. The visualization shows the existence of 4 interconnected clusters, illustrating a comprehensive topic framework.

1. First Cluster: Disaster. This cluster highlights things related to disasters including action, book, case study, change, child, crisis, data, development, disaster, early childhood, early year, example, framework, knowledge, lesson, life course, management, natural disaster, person, policy, practice, research, resilience, risk, role, social medium, theory, and world. Related to disasters, it describes the actions taken by people, including children as victims, who are required to have an attitude of resilience in facing disasters. Knowledge about disasters is important, one of which is supported by literacy media such as books.

2. Second Cluster: Covid. This cluster describes discussions about catastrophe, challenge, covid, distance, e learning, emergency remote teach, experience, face, higher education, learning, medical education, online, online course, online learning, opportunity, pandemic, student, teacher, teaching, term, time and university. Covid that

has hit the world requires everyone to keep their distance. However, the educational process continues with a number of challenges. The trend of online learning and online media is the right time to gain distance learning experience, one of which is through e-learning. Apart from being a disaster for people around the world, this Covid disaster is also an opportunity to change the learning paradigm which can be done remotely.

3. Third Cluster: Information. The fourth cluster discusses care, communication, community, curriculum, effect, emergency department, health, health care, level, life, patient, quality, state, systematic review, training, and treatment. Information is necessary and has a big influence on society regarding the world of disasters. In emergency situations, the accuracy of information is very important for emergency response. ICT plays an extraordinary role in providing speed and accuracy in responding to emergencies. The disaster curriculum has experienced extraordinary development by making ICT an inseparable part of the content and learning media.

4. Fourth Cluster: Technology Communication. This fourth cluster describes technology communication which in the search is recorded in the following words, namely application, approach, communication system, context, country, curriculum, emergency response, emergency situation, ict, icts, information, internet, smart city, strategy, and surveys. Technology communication was developed in the context of risk reducing disasters through various approaches such as integrated communication systems, ICT approaches, emergency application development, information technology-based disaster mitigation curriculum, learning application development, disaster response smart city development, and ICT-based emergency response. The use of communication technology is one strategy for responding quickly during emergency situations. Technology-based information is an effort to reduce the risk of disasters because the speed of information is part of the attitude of anticipating emergency conditions.

Analysis of inter-cluster relationships shows that there are relationships that reflect complexity and significance between topics in the ICT-based Disaster Curriculum in Early Childhood Education. For example, disaster education can help develop creativity in developing digital-based learning media, healthy internet and other information technology insights. Thus, the visualization results with VOSviewer appear to provide rich knowledge about the dynamics and relationships between these important elements. These insights can enrich ideas to become guidelines for improving and perfecting the development of disaster curricula that are more appropriate for early childhood in the current context in the era of communication technology.

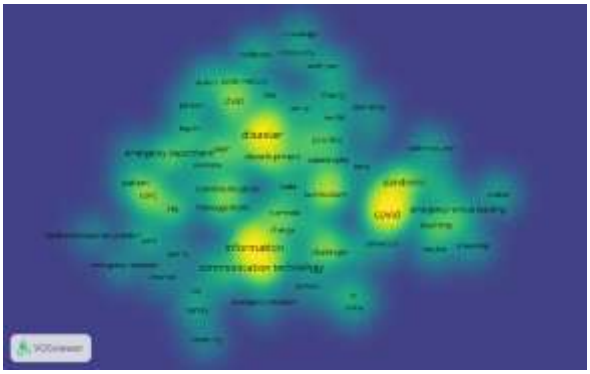

Figure 3. Density Visualization by VOSviewer

The significant upward trend in ICT-integrated disaster curricula observed after 2020 suggests a critical ontological shift in early childhood pedagogy. From an ontological perspective, disaster resilience is no longer viewed merely as a set of physical drills, but as a socially constructed reality mediated by digital interaction. The surge in digital media usage reflects a global response to the limitations of physical learning during the pandemic, where ICT served as a vital bridge for simulating high-risk scenarios in a safe, controlled environment. However, this trend also reveals a 'digital-pedagogical gap'; while technology offers immersive experiences, its effectiveness remains contingent upon the teacher's ability to facilitate meaningful dialogue around the digital content. Therefore, the findings imply that ICT media should not replace direct experience but should function as a scaffolding tool that enhances children's cognitive and emotional readiness in facing environmental uncertainties.

In the context of the trend of ICT-based disaster curriculum development in early childhood, the application of analysis through VOSviewer density visualization is the basis for developing content and ideas for curriculum development. The main aim of applying density visualization in this context is to open and expand points of view as well as as a guide in determining priorities. From this visualization, density becomes an illustration for policy makers and disaster curriculum developers to be able to clearly identify areas or topics with high focus or priority. This depiction through visualization can enable curriculum development to concentrate more on the most relevant and critical aspects for deepening understanding. This visualization also helps identify relationships and interrelationships between elements in the disaster curriculum. Through this depiction, it allows curriculum developers to design a coherent and integrated structure because it involves understanding interrelated concepts and topics.

Visualization supports data-driven decision making. This is because using density visualization can help make more informative and data-based decisions. Complex amounts of data can be described and interpreted more easily. This step allows decision makers to identify trends, patterns and potential improvements more quickly. Other goals include optimizing student learning experiences. Curriculum developers can

design disaster-related learning experiences to be more focused and meaningful for students through density visualization. Networking and interconnection make disaster learning easy and meaningful, thereby helping students develop a deeper understanding and introduce skills that are relevant to early childhood in the current context in the era of technological communication. Increasing Transparency and Communication: Density visualization also plays a role in increasing transparency and communication between stakeholders involved in disaster curriculum development. All stakeholders, including the government, school institutions, disaster organizations and the community, can see more clearly the structure and focus of the curriculum. This stage opens up space to facilitate better discussion and collaboration. This visualization also encourages an attitude of always trying to adapt to changes that occur more responsively. This is considering the extent of interconnection which is likely to be influenced by the world of business and renewable technology. This always-adaptive attitude means curriculum developers can quickly adjust content and focus to remain relevant to the latest needs and developments. The evaluation step includes discussing effectiveness and impact. With density visualization, it is very helpful to measure the relevance, effectiveness of the curriculum and its impact on students. By thus monitoring the density of certain elements, curriculum developers can evaluate the extent to which this disaster curriculum can achieve the desired learning objectives.

With this, the use of density visualization in the development trend of ICT-based disaster curricula for early childhood education in early childhood education functions as an important instrument for designing, managing and perfecting the curriculum. This improvement work is carried out so that the disaster curriculum becomes a tool in developing children's abilities and knowledge to know what to do when a disaster occurs and after a disaster.

From the search results, it was decided to review 9 articles as presented in the following table.

Table 1. Articles to be Compared

No	Researcher Name	Article title	Research result
1.	(Kousky, 2016)	Impacts of Natural Disasters on Children.	Three impacts of natural disasters often occur on children, (1) disasters can damage physical health, be injured or killed, malnutrition, diarrheal disease caused by contaminated water. (2) disasters can cause mental health problems, stress, fear, and sadness. (3) disasters can disrupt education and encourage children to enter the world of work to help their families meet their living needs in difficult times. How can we mitigate these things? One way is to mitigate disasters, for example by strengthening

No	Researcher Name	Article title	Research result
			school buildings and houses. There are actions that have been proven to help children after a disaster, such as immediately reuniting them with their parents and caregivers. Additionally, using an existing safety net program may be easier, faster, and more effective than creating an entirely new program after a disaster occurs.
2.	Pokhrel & Chhetri, (2021)	A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. *Higher Education for the Future*	The education system and the educators have adopted "Education in Emergency" through various online platforms and are compelled to adopt a system that they are not prepared for. The use of suitable and relevant pedagogy for online education may depend on the expertise and exposure to information and communications technology (ICT) for both educators and learners. The flipped classroom is a simple strategy for providing learning resources such as articles, pre-recorded videos, and YouTube links before the class. This is a very effective way of encouraging skills such as problem-solving, critical thinking, and self-directed learning.
3.	Marsh, J., Hannon, P., Lewis, M., & Ritchie, (2017)	Young children's initiation into family literacy practices in the digital age.	Considering socio-cultural developments in the new media era, it is necessary to change the focus from 'family literacy' to 'family digital literacy'. This is because children are immersed in a variety of multimedia and multimodal practices that involve extensive engagement with other family members who play a role in their learning and delight in children's technological capabilities.
4.	Joshua Whittaker, Blythe McLennan, John Handmer, (2015)	A review of informal volunteerism in emergencies and disasters: Definition, opportunities and challenges,	The author discusses the role of informal volunteers in emergency and disaster management. Two types of informal volunteerism are identified which are emerging and which are widespread and their implications for emergency and disaster management are considered. Special attention is paid to increasing 'digital volunteerism' as it becomes easier to access sophisticated yet simple information and communication technologies. Cultural and legal responsibilities were identified as key barriers to increasing informal volunteer participation. We argue that more adaptive and inclusive emergency and disaster

No	Researcher Name	Article title	Research result
			management models are needed to harness existing capacity and resilience within and across communities.
5.	Didham & Ofei-Manu, (2020)	Adaptive capacity as an educational goal to advance policy for integrating DRR into quality education for sustainable development	Disaster management learning is taught with an adaptive capacity building model that supports pedagogical design, strengthens the learning process for competency development, and may be in line with the main goal of achieving quality education for sustainable development, implementing a well-developed curriculum, improving the quality of teaching methods, building a safe and secure environment. effective. learning environment, and inspiring cooperative and transformative learning.
6.	Sarafova, (2023)	Communicating disasters to children through digital learning activities, geospatial data and flatforms.	Natural disasters can have a significant impact on children's well-being, so it is important to effectively communicate risks and potential dangers to them. The authors outline a holistic, data-driven approach to increasing children's resilience by leveraging geospatial data and maps used in the classroom. Students carry out various practical activities to study natural disasters and their impacts. Kids explore flooding in different regions using a virtual globe, visualize forest fires using a satellite data platform, and study plate tectonics using a virtual globe. Students can also work with the KML dataset containing fault lines and GIS layer points of all earthquakes in the country since the beginning of the 20th century, as well as explore the country's list of landslides using various maps and layers. This activity gives students hands-on experience in using technology and data to understand natural disasters and their impacts.
7.	Rodavia, M. R. D., Curato, I. S. C., & Pitagan, F. B.Rodavia, M. R. D., Curato, I. S. C., & Pitagan, (2018)	Online Disaster Preparedness Application for Kids	The author designed and created an Integrated STEM module with natural disasters, especially earthquakes as a real world situation. The state of disaster literacy is still in its early stages and much still needs to be done to increase awareness of the impacts of natural disasters among school children. The results showed differences between pre- and post-test scores indicating students' mastery and positive feedback from them indicating their acceptance

No	Researcher Name	Article title	Research result
			of integrated STEM learning. This study provides evidence that these activities have proven beneficial and more efforts should be made in determining STEM curriculum compliance to improve student learning.
8.	Z. Ismail, F. M. Mohamad, H. Harun, N. A. Muda and Y. M. Yusof, (2017)	"Integrated Science, Technology, Engineering, Mathematics Learning in Natural Disaster Earthquake among Form Two Students,".	Research on the use of disaster video games as a learning tool brings together teacher and student perspectives to consider how to encourage children's participation in DRR and support the goals of the Sendai Framework. This paper summarizes a video game research project using three sets of case studies. This process has produced real and meaningful results based on teacher and student needs and offers potential pathways to address gaps in policy and practice to reduce risks associated with disasters.

ICT media in the Disaster Curriculum is important, especially in the context of learning in the digital era. As young children currently live in the digital era, it is inevitable that they come into contact with digital devices. In order to prepare learning, especially the implementation of the disaster curriculum, the urgency of the ICT-based disaster curriculum for Early Childhood Education is as follows:

1. ICT media functions as a tool/media (means) to achieve disaster education goals increasing access to education, increasing efficiency and the quality of learning and teaching.
2. ICT as access to education in implementing the Disaster Curriculum. The use of ICT will expand the reach and services of education. Distance can be no problem in learning because it uses internet access.
3. ICT in implementing the learning curriculum can increase efficiency. This makes the learning budget more affordable.
4. The quality of learning and teaching becomes better with the use of ICT. ICT also has the potential to be used to teach various abstract, dynamic, difficult subject matter, as well as skills through animation and simulation.
5. Using ICT can stimulate creativity and critical thinking skills.

Thus, the use of ICT in the disaster curriculum that is packaged well by teachers can improve the quality of learning to make it meaningful and enjoyable. However, the usage portion must still pay attention to the child's development..

4. CONCLUSION

Children are a vulnerable group who become victims if a disaster occurs. They need more protection than adults in general. However, disasters can happen at any time

and anywhere. It is possible that when a disaster occurs the child is not with his parents. In conditions like this, what parents must do is equip them with knowledge, skills, readiness and resilience. Efforts that can be made are through disaster education.

A good disaster education program is certainly supported by a good, suitable curriculum concept. So the preparation of the disaster curriculum must be adjusted to the development, needs and best things for the child. From a good curriculum, teachers can create good learning, teachers also prepare media, methods and approaches that are suitable for children. In the current context, the curriculum must be friendly to rapid changes, especially those experienced by children. Children now live in a fast flow of information, so teachers must be prepared for these conditions. ICT is a part that begins to be used according to the child's development.

From a systematic search of this literature review, the author found that there are still few studies of the ICT-based Disaster Curriculum specifically for early childhood. A number of literature resulting from studies describe the concept, development and implementation of disaster curricula at higher levels of education, using a conventional approach..

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In conclusion, this systematic review underscores that the evolution of disaster curricula for early childhood from 2013 to 2023 has been increasingly defined by technological integration and multimodal learning. This study successfully maps the global landscape of these trends, demonstrating a consistent alignment between the research objectives and the synthesized findings. The practical implication for

curriculum developers, particularly in disaster-prone regions like Indonesia, is the urgent need to transition from conventional instructional methods to interactive, ICT-based frameworks. By synthesizing diverse global practices, this research contributes a strategic roadmap for designing 'digital-native' disaster curricula that are both scientifically robust and developmentally appropriate for young learners. Future research should prioritize the longitudinal impact of specific ICT tools on long-term disaster-response behaviors to further validate these pedagogical shifts.

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Mindfulness-Based Learning and Guidance Innovations to Improve Academic Resilience of Junior High School Students in the Digital Era

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ABSTRACT

Junior high school students are at a stage of development that is vulnerable to academic pressure due to high learning demands and the influence of the digital environment. Academic resilience is an important skill that enables students to persevere and bounce back from learning difficulties. One factor that plays a role in the formation of academic resilience is mindfulness, which is the awareness of the present moment in an open and non-judgmental manner. This study aims to analyze the relationship between mindfulness and students' academic resilience and to develop ideas for mindfulness-based learning and guidance innovations in schools. The study uses a correlational quantitative approach with the Spearman-Brown technique. The research population involved all eighth-grade students at SMP Negeri 12 Bandung, selected using a saturated sampling technique. The instruments used included the Kentucky Inventory of Mindfulness Skills (KIMS) to measure mindfulness and the Academic Resilience Scale (ARS-30) to measure academic resilience. The results showed that the students' mindfulness level was in the moderate category, while their academic resilience was in the high category. Data analysis shows a positive and significant relationship between mindfulness and academic resilience, albeit in the weak category. These findings provide a basis for developing innovative mindfulness-based learning and guidance services to strengthen students' academic resilience and emotional well-being in the digital age.

Keywords: *academic resilience, digital era, mindfulness, guidance and counseling, learning innovation.*

1. INTRODUCTION

The development of digital technology over the past decade has brought significant changes to the learning environment of junior high school students. Widespread access to digital devices, social media, and unlimited information has opened up opportunities for improved learning resources and collaboration, but it has also presented challenges in the form of distractions, mental fatigue, decreased focus, and increased academic pressure (Livingstone, 2012; Rosen et al., 2014; Twenge, 2017). The habit of digital multitasking has been shown to reduce learning effectiveness, disrupt long-term concentration, and negatively impact students' psychological well-being (Ophir et al., 2009; Lemola et al., 2015).

Junior high school students in early adolescence are highly vulnerable to academic stress and emotional instability due to simultaneous biological, cognitive, and social developmental changes (Santrock, 2018; Steinberg, 2014). In the context of increasingly complex digital learning, this condition increases the risk of prolonged

academic stress, decreased learning motivation, and the emergence of anxiety and emotional pressure (Pascoe et al., 2020).

In such situations, academic resilience becomes a key ability that enables students to persevere, adapt, and bounce back from learning difficulties. Academic resilience is understood as the capacity of students to maintain motivation, manage negative emotions, and respond constructively to academic failure (Cassidy, 2016; Martin & Marsh, 2009). Research shows that students with high academic resilience tend to have better academic achievement and optimal psychological well-being (Datu & Yuen, 2018; Yeager & Dweck, 2012).

One of the internal factors that play a role in strengthening academic resilience is mindfulness. Mindfulness refers to the ability to be consciously present in the current experience with an attitude of acceptance without judgment (Kabat-Zinn, 2003). In an academic context, mindfulness helps students improve emotional regulation, reduce distractions, and respond to learning pressures in a more adaptive manner (Bishop et al., 2004; Meiklejohn et al., 2012). Various studies show that mindfulness is associated with increased focus, cognitive flexibility, and reduced academic stress, including in digital learning environments (Bajaj & Pande, 2016; Zenner et al., 2014).

Although the effectiveness of mindfulness in the context of education has been extensively researched in Western countries, studies that specifically explore the relationship between mindfulness and academic resilience in junior high school students, particularly in facing learning challenges in the digital age, are still limited. Therefore, this study aims to analyze the relationship between mindfulness and academic resilience in junior high school students and formulate innovative learning ideas and mindfulness-based guidance services that are relevant to the educational context in the digital age.

2. METHODOLOGY

This study uses a quantitative approach. The quantitative approach in this study is used to obtain numerical data on the relationship between mindfulness and academic resilience in eighth-grade students at SMP Negeri 12 Bandung in the 2024/2025 academic year. The choice of a quantitative approach is based on Creswell's (2012) statement that in quantitative research, researchers identify research problems based on what is currently happening in the field or on the need to explain why something is happening.

2.1. Research Design

Correlational research design is used to examine the relationship between two variables without manipulating the conditions of the students. The correlational method is a method in quantitative research to measure the degree of relationship between two

or more variables using correlational analysis statistical procedures (Creswell, 2012). The research design used is a cross-sectional survey. Cross-sectional surveys are used to test the relationship between variables at a single point in time. This method can be used to establish patterns and correlations between variables (Creswell, 2014).

2.2. Participants of the Study

The research population consists of all eighth-grade students at SMP Negeri 12 Bandung in the 2024/2025 academic year. The technique used is a saturated sample, so that the entire population is used as the research sample.

2.3. Instruments

This article uses two instruments, namely (1) Mindfulness measured using the Kentucky Inventory of Mindfulness Skills (KIMS), consisting of four aspects: observing, describing, acting with awareness, and accepting without judgment. (2) Academic resilience measured using the Academic Resilience Scale (ARS-30), which covers the aspects of perseverance, reflecting and adaptive help-seeking, and negative affect & emotional response. These instruments have been tested for validity and reliability and are deemed suitable for use.

2.4. Data Analysis Techniques

The data were analyzed using Spearman-Brown correlation tests through the SPSS application. Descriptive analysis was used to determine the categories of mindfulness and academic resilience scores.

3. RESULT AND DISCUSSION

3.1 Result

This study produced three main findings that describe the conditions of mindfulness, academic resilience, and the relationship between these two variables among students at SMP Negeri 12 Bandung.

Table 1. Conditions of Mindfulness

Variabel	Kategori	Frekuensi	Persentase	Total
Mindfulness	Sangat Rendah	19	6,0	318 (100%)
	Rendah	13	4,1	
	Sedang	281	88,4	
	Tinggi	0	0,0	
	Sangat Tinggi	5	1,6	

The results of the frequency distribution analysis show that 88.4% (281 students) of mindfulness tendencies were in the moderate category, 6.0% (19 students) were in the very low category, 4.1% (13 students) were in the low category, and 1.6% (5 students) were in the very high category. Meanwhile, no students (0.0%) were in the high category.

Table 2. Conditions of Academic Resilience

Variabel	Kategori	Frekuensi	Persentase	Total
Resiliensi Akademik	Sangat Rendah	5	1,6	318 (100%)
	Rendah	7	2,2	
	Sedang	133	41,8	
	Tinggi	156	49,1	
	Sangat Tinggi	17	5,3	

The results of the study on the variable of academic resilience show that students have high academic resilience. The majority of students (67.3%) are in the high category, and 24% are in the very high category. Only a small proportion of students (8.7%) are in the moderate category, and no students are in the low or very low categories. These findings indicate that students have good adaptive abilities in coping with learning pressures, including the ability to persevere in the face of obstacles, engage in academic reflection, and seek help when needed.

Table 3. Relationship Between Each Aspect of Mindfulness and Academic Resilience

Spearman's rho		**Resiliensi Akademik**
Mindfulness (X)	Correlation Coefficient	0,143**
	Sig. (1 tailed)	0,005
	N	318
Mengamati	Correlation Coefficient	0,186**
	Sig. (1 tailed)	0,000
	N	318
Menggambarkan	Correlation Coefficient	0,143**
	Sig. (1 tailed)	0,005
	N	318

Spearman's rho		Resiliensi Akademik
Bertindak dengan Kesadaran	Correlation Coefficient	0,089
	Sig. (1 tailed)	0,057
	N	318
Menerima tanpa Menghakimi	Correlation Coefficient	-0,170**
	Sig. (1 tailed)	0,001
	N	318

Further analysis of the relationship between each aspect of mindfulness and academic resilience yielded the following results.

1. The aspect of observation has a correlation coefficient of 0.186 with a significant value of 0.000 ($p < 0.01$). These results indicate a significant positive relationship with a weak correlation strength between an individual's ability to consciously observe experiences and academic resilience. This shows that students' ability to observe internal and external experiences (such as emotions, thoughts, and the environment) has a real contribution to their academic resilience.
2. The describing aspect showed a correlation of 0.143 with a significance value of 0.005 ($p < 0.01$), indicating a significant but weak positive relationship between the ability to verbally express internal experiences and academic resilience. This indicates that students' ability to consciously label or describe experiences is also related to an increase in their resilience in facing academic challenges.
3. The aspect of acting with awareness has a correlation coefficient of 0.089, with a significance value of 0.057 ($p > 0.05$). These results indicate that there is a positive but insignificant relationship between the aspect of acting with awareness and academic resilience. This means that the ability of students to act with full awareness (focus on the present moment) has no relationship with academic resilience in this study.
4. The aspect of accepting without judging shows a coefficient value of -0.170 with a significance of 0.001 ($p < 0.01$). This negative correlation indicates that there is a significant but negative inverse relationship between the aspect of accepting without judging and academic resilience. In other words, the tendency to accept internal experiences without judging is associated with opposite academic resilience scores. This means that the more students show an attitude of accepting internal experiences without judging, the more likely they are to experience a decline in academic resilience.

Next, the coefficient of determination (CD) was calculated to determine the extent of mindfulness' contribution to students' academic resilience, using the following formula.

KD = R^2 x 100%

= $0{,}143^2$ x 100%

= 2,04%

Based on the calculation of the coefficient of determination, a coefficient of determination of 2.04% was obtained. This means that the contribution of mindfulness to academic resilience is very low, so that there are still 97.96% other factors outside of mindfulness that influence the academic resilience of students. This shows that although there is a significant relationship between the two variables, the direct influence of mindfulness on academic resilience is not dominant and needs to be examined together with other variables in a broader context.

Overall, the findings indicate that mindfulness contributes to students' academic resilience, but this contribution is not dominant and is influenced by other factors such as family support, school environment, classroom climate, and students' learning habits in the digital age.

3.2 Discussion

The results of the study show that junior high school students' mindfulness levels are in the moderate category, while academic resilience is in the high category. These findings indicate that students' academic adaptation abilities are relatively good, even though their mindfulness-based self-regulation capacities have not yet developed optimally. This condition is in line with the theory of early adolescent development, which states that attention control and emotional regulation abilities are still in the developmental stage, making adolescents prone to distraction and academic pressure, especially in a stimulus-rich digital environment (Santrock, 2018; Steinberg, 2014).

Correlation analysis shows that mindfulness has a positive and significant relationship with academic resilience, albeit with a weak relationship strength. This finding is consistent with the research by Bajaj and Pande (2016), which states that mindfulness contributes to resilience through improved emotional regulation and reduced stress responses, but not as a single factor. Martin and Marsh (2009) and Cassidy (2016) also emphasize that academic resilience is a multidimensional construct influenced by the interaction between intrapersonal and environmental factors, so the relatively small contribution of mindfulness in this study can be understood theoretically.

From the perspective of mindfulness, observing shows the strongest relationship with academic resilience. This is in line with the concept of mindfulness proposed by Kabat-Zinn (2003), which emphasizes awareness of current experiences as the

foundation of self-regulation. The ability to observe thoughts, emotions, and learning situations allows students to recognize academic stress earlier and respond to it adaptively. These findings are supported by research by Moore and Malinowski (2009) and Chambers et al. (2009), which shows that mindfulness increases cognitive flexibility and emotional regulation, which are important components of academic resilience.

The aspect of describing also shows a positive and significant relationship with academic resilience. The ability to name and express internal experiences helps students understand learning difficulties more objectively and encourages the use of constructive coping strategies. Bishop et al. (2004) state that the ability to describe experiences is part of metacognitive awareness that supports psychological adaptation. Thus, students who are able to express their thoughts and feelings related to academic challenges tend to be more resilient in facing learning pressures.

Conversely, the aspect of acting with awareness did not show a significant relationship with academic resilience. These findings indicate that focusing on current activities does not necessarily contribute directly to academic resilience if it is not accompanied by reflection and environmental support. In addition, the aspect of non-judging showed a significant negative relationship with academic resilience. This finding can be explained through the perspective of Neff et al. (2005), who emphasize that self-acceptance needs to be accompanied by self-compassion so that it does not develop into a passive attitude towards failure. In the context of adolescents, an accepting attitude without adaptive reflection can be interpreted as resignation, thus not encouraging efforts to solve academic problems.

The low coefficient of determination value indicates that students' academic resilience is more influenced by factors outside of mindfulness. Research by Datu and Yuen (2018) and Suharti and Nugraha (2023) confirms that social support, relationships with teachers and peers, and school climate play a dominant role in shaping academic resilience. Thus, mindfulness functions as an internal protective factor that strengthens self-awareness and emotional regulation, but its effectiveness is highly dependent on a supportive learning environment.

The implications of these findings suggest that the development of mindfulness-based learning innovations and guidance services needs to be carried out in an integrated manner. The integration of simple mindfulness exercises into learning, such as mindful breathing and guided reflection, is in line with the findings of Meiklejohn et al. (2012) and Zenner et al. (2014), which show that mindfulness practices in schools can improve students' focus, emotional well-being, and resilience. In the context of guidance and counseling, mindfulness-based intervention approaches have also been shown to be effective in helping students manage academic stress and emotional pressure (Felver et al., 2016; Klingbeil et al., 2017).

Overall, this study reinforces previous findings that mindfulness plays an important but limited role in building students' academic resilience. Therefore, mindfulness needs to be positioned as part of a holistic approach combined with environmental support, strengthening of social-emotional skills, and healthy digital literacy in order to have a more optimal impact on students' academic resilience in the digital age.

4. CONCLUSION

This study concludes that mindfulness has a positive and significant relationship with the academic resilience of junior high school students, although the strength of the correlation is in the weak category. These findings indicate that mindfulness still plays a role in supporting students' ability to cope with learning pressures, maintain motivation, and recover from failure, but it is not a major determining factor. Each aspect of mindfulness shows a different relationship pattern, where observing and describing have a significant contribution to academic resilience, while acting with awareness shows no significant relationship and non-judging shows a negative relationship. This variation indicates that mindfulness works in a complex manner and is influenced by the context of adolescent development and the dynamics of learning in the digital age.

In addition, the low contribution of mindfulness to academic resilience (2.04%) indicates that resilience is largely shaped by a combination of intrapersonal and social environmental factors. Factors such as family support, peer relationships, interactions with teachers, and school culture have a greater influence in shaping students' resilience to academic challenges. However, mindfulness still provides an important foundation in helping students increase self-awareness, manage emotions, and respond to digital distractions in a more adaptive manner. This is in line with the literature which confirms that mindfulness can be a protective mechanism for adolescents in dealing with academic stress and the pressures of the modern learning environment.

Based on these findings, this study emphasizes the importance of developing mindfulness-based learning innovations and guidance services in schools. Integrating mindfulness exercises into learning activities, such as conscious breathing, reflection breaks, or full attention when completing tasks, can help students improve their focus and emotional regulation. Meanwhile, school counselors can develop mindfulness-based counseling programs to strengthen students' academic resilience and emotional well-being. Thus, mindfulness is not only a self-management strategy, but also a relevant pedagogical and psychological approach to be applied in facing the complexities of academic and digital challenges in today's youth.

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Literature Review: The Role of Self-disclosure in Mindful, Meaningful, and Learning in The Digital Age

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ABSTRACT

The development of digital technology has brought fundamental changes to the learning paradigm, shifting traditional approaches towards more interactive, reflective, and collaborative learning models. Self-disclosure has become an important element in building authentic educational interactions between educators and students. Through self-disclosure, learners can constructively express their thoughts, emotions, and personal3 experiences, making the learning process more mindful, meaningful, and enjoyable. However, the practice of self- disclosure in the digital space presents new and complex challenges, particularly regarding privacy issues, ethical boundaries of communication, and the balance between self-expression and social responsibility. This study aims to analyze the role of self-disclosure in building a digital learning ecosystem that supports students' psychological well-being and engagement. The research method uses a Systematic Literature Review (SLR) approach by examining various relevant national and international scientific publications. The results of the study show that self-disclosure contributes significantly to strengthening interpersonal relationships, increasing empathy, and forming mutual trust, which are the basis for creating a collaborative learning climate. When managed consciously and reflectively, self-disclosure not only enriches learning interactions but also fosters self-awareness, emotional regulation, and healthy digital literacy. Thus, self-disclosure functions as a pedagogical instrument that supports humanistic learning in the digital age. The implications of this study emphasize the importance of pedagogical strategies based on self-reflection, communication ethics, and digital balance to create meaningful, inclusive learning experiences that are oriented towards the psychological well-being of students.

Keywords: *digital learning, mindful learning, psychological well-being, self-disclosur*

1. INTRODUCTION

The development of digital technology has significantly changed the landscape of education, especially in the way teachers and students interact, construct meaning in learning, and form emotional engagement in the learning space. This transformation has not only opened up new opportunities in the learning process, but has also raised challenges related to the quality of pedagogical relationships, the depth of learning experiences, and the fulfillment of students' psychological needs. Therefore, learning in the digital age should not only focus on mastering technology, but should also prioritize approaches that pay attention to the human dimension in the learning process.

In line with the demands of 21st-century pedagogy, learning is required to be mindful, meaningful, and enjoyable (Lombardi, 2007; Langer, 2014). Mindful learning emphasizes full awareness and the complete presence of learners in the learning

process, enabling them to consciously reflect on their learning experiences (Langer, 1989). Meaningful learning emphasizes the connection between subject matter and learners' experiences, values, and life goals, enabling the formation of deeper and more sustainable understanding (Ausubel, 1968). Meanwhile, enjoyable learning is rooted in a positive emotional climate that encourages intrinsic motivation, creativity, and psychological security (Fredrickson, 2001; Pekrun, 2006).

Although these three principles have been widely discussed in pedagogical literature, their implementation in learning especially in digital environments still faces various obstacles. One aspect that is often overlooked is the quality of interpersonal interaction between teachers and students. Learning interactions that lack emotional closeness have the potential to make the learning process mechanical, less reflective, and disconnected from the personal experiences of students.

It is in this context that self-disclosure becomes relevant to study. Self-disclosure is not merely understood as sharing personal information, but as an interpersonal process that plays a role in building trust, closeness, and emotional connection between individuals (Jourard, 1971; Derlega et al., 1993). In learning, the practice of self-disclosure by both teachers and students can create a more authentic and humanistic space for dialogue, so that students feel recognized, accepted, and valued as individuals (Cayanus & Martin, 2008).

A number of studies show that self-disclosure has an important contribution to various dimensions of learning. In mindful learning, self-disclosure can increase self-awareness, emotional recognition, and reflective abilities in students (Brown & Ryan, 2003). In meaningful learning, self-disclosure helps learners relate the subject matter to their life experiences, thereby supporting a more personal meaning-making process (Kember et al., 2008). Meanwhile, in enjoyable learning, self-disclosure plays a role in creating emotional warmth, social closeness, and a classroom atmosphere that supports positive motivation (Titsworth et al., 2010).

However, the digital age presents its own complexities in the practice of self-disclosure. Digital media allows self-disclosure to be carried out through various forms of communication, such as text, audio, and video, which have the potential to increase social presence in online learning (Garrison et al., 2000). On the other hand, this practice also raises issues related to professional boundaries, privacy, and ethics that need to be carefully managed so that self-disclosure continues to function pedagogically and does not pose a risk to teachers or students (Ledbetter et al., 2011).

2. METHODOLOGY

2.1. Research Design

This study employed a systematic literature review (SLR) to examine the role of self-disclosure in supporting mindful, meaningful, and enjoyable learning within digital

learning contexts. The review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency, rigor, and replicability in the review process (Page et al., 2021).

The SLR process consisted of four main stages: identification, screening, eligibility, and inclusion. Through these stages, relevant studies were systematically identified, evaluated, and synthesized to map conceptual relationships and pedagogical implications related to self-disclosure and mindfulness in digital learning environments. The review was guided by the following research questions:

RQ1: How is self-disclosure conceptualized in digital learning contexts?

RQ2: What roles does self-disclosure play in supporting mindful and meaningful learning in digital environments?

RQ3: What pedagogical implications emerge from the integration of self-disclosure and mindfulness in digital learning?

2.2. Literature Search Strategy

A comprehensive literature search was conducted using several academic databases to capture relevant and high-quality studies. The databases included Scopus, Web of Science, ERIC, and Google Scholar, as these platforms index peer-reviewed journals in education, psychology, and communication studies. The search process was carried out between January 2025 and March 2025.

2.3. Inclusion and Exclusion Criteria

Clear inclusion and exclusion criteria were applied to ensure the relevance and quality of the selected studies. Articles were included if they met the following criteria:

1. Published between 2015 and 2025
2. Written in English
3. Published in peer-reviewed and reputable journals
4. Addressed self-disclosure, mindfulness, meaningful learning, or related constructs within digital or online learning contexts
5. Presented empirical findings or conceptual analyses relevant to the research questions

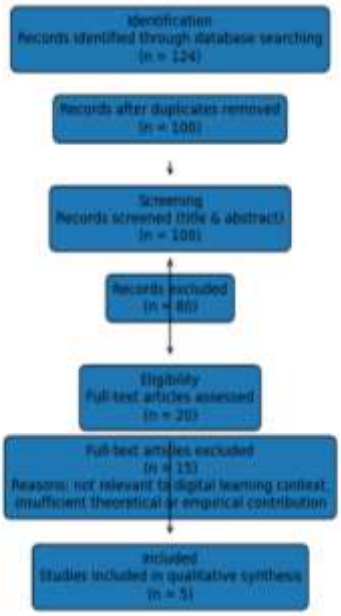

Figure 1. PRISMA Diagram

3. RESULT AND DISCUSSION

RESULT

To comprehensively understand how self-disclosure contributes to mindful, meaningful, and enjoyable learning in the digital age, it is necessary to examine the key findings from various recent studies. The literature reviewed in this section includes studies that highlight self-disclosure in the context of online learning, interpersonal relationship dynamics, psychological well-being on social media, and the role of mindfulness in the learning process. Each study provides a different but complementary perspective, ranging from how teacher self-disclosure strengthens social presence, how reciprocal disclosure mechanisms build interpersonal closeness, to how mindfulness as a trait and as a learning process shapes the quality of interactions and learning experiences. The following table summarizes the main references and their key findings to show how self-disclosure and mindfulness create a more humanistic and engaging learning ecosystem in the digital space.

Table 1. Summarizes The Main References

Reference	Result
Song, H., Kim, J., Park, N. (2019). I Know My Professor: Teacher Self-Disclosure in Online Education and a Mediating Role of Social Presence. International Journal of Human-Computer Interaction.	Teachers' self-disclosure enhances social presence, which in turn strengthens learning satisfaction, emotional connection, and student engagement. Positive effects emerge when disclosures are relevant, professional, and purposeful.

Reference	Result
Sprecher, S., & Treger, S. (2015). The benefits of turn-taking reciprocal self-disclosure in get-acquainted interactions. Personal Relationships.	Self-disclosure that is done alternately (turn-taking) and reciprocally increases closeness, mutual trust, and sympathy more effectively than one-way disclosure.
Chu, T. H., Sun, M., & Crystal Jiang, L. (2023). Self-disclosure in social media and psychological well-being: A meta-analysis. Journal of Social and Personal Relationships.	There is a positive relationship between self-disclosure and psychological well-being, depending on the valence of disclosure, privacy control, and social support provided. Supportive responses to disclosure increase well-being, while unsafe digital contexts can have a negative impact.
Yeh, Y.-C., Chang, H.-L., & Chen, S.-Y. (2019). Mindful learning: A mediator of mastery experience during digital creativity game-based learning among elementary school students. Computers & Education.	Mindful learning, which includes full attention, reflection, and conscious engagement, mediates the positive impact of digital creative experiences on learning outcomes. Design elements such as feedback and structured reflection play an important role.
Ketay, S., Thorson, K. R., Roy, A. R. K., & Welker, K. M. (2023). Trait Mindfulness is Associated with Self-Disclosure and Responsiveness During Social Interactions with New Acquaintances. Mindfulness.	Individuals with higher levels of mindfulness tend to express themselves in a more contextually aware and balanced manner, and demonstrate greater responsiveness in social interactions.

DISCUSSION

A synthesis of the literature shows that self-disclosure plays a central role in shaping the quality of learning in the digital age, which is not only informative, but also mindful, meaningful, and enjoyable. Findings from various studies indicate that the quality of self-disclosure by both educators and learners contributes to the creation of more humane, reflective, and emotionally adaptive learning interactions.

Research by Song, Kim, and Park (2019) shows that teacher self-disclosure that is conveyed in a relevant and professional manner can increase social presence in online learning. This increase in social presence has an impact on increasing learning satisfaction, a sense of connection, and student engagement. These findings indicate that educator self-disclosure is not merely a form of personal communication, but a pedagogical strategy that can strengthen the quality of attention, warmth, and harmony of interaction important elements in mindful and meaningful learning.

In line with this, research by Sprecher and Treger (2015) emphasizes the importance of reciprocal and turn-taking self-disclosure in building healthy interpersonal relationships. Alternating patterns of disclosure encourage more balanced interactions, based on mutual trust and sympathy. In the context of digital learning, this principle can be adapted into activity designs that foster social awareness and emotional presence, such as reflective discussions, small group work, or structured

sharing sessions. This reinforces that self-disclosure is not merely an interpersonal activity, but a pedagogical instrument for fostering enjoyable and supportive learning experiences.

From a psychological well-being perspective, a meta-analysis by Chu, Sun, and Crystal Jiang (2023) shows that self-disclosure has a moderate positive relationship with well-being, especially when it occurs in a safe context and receives supportive social responses. These findings emphasize that mindful digital learning designs need to consider aspects of emotional safety, communication ethics, and privacy regulations. This allows learners to express their experiences and reflections without the risk of negative judgment, ultimately increasing their comfort and motivation to learn.

Furthermore, the study by Yeh, Chang, and Chen (2019) places mindful learning as an important mediator between digital creative learning experiences and mastery of material. The mindful process—which includes full attention, reflection, and conscious engagement—not only strengthens learning effectiveness, but also creates psychological conditions conducive to the emergence of safe and meaningful self-disclosure. In other words, mindfulness serves as an emotional foundation that allows learners to share their learning experiences honestly and reflectively.

In terms of individual characteristics, Ketay and colleagues (2023) found that dispositional mindfulness levels are associated with more adaptive self-disclosure and higher interpersonal responsiveness. This suggests that integrating mindfulness practices into learning can help students develop social sensitivity, emotional awareness, and balance in self-expression. Improvements in the quality of interpersonal interactions directly contribute to the creation of a more positive, enjoyable, and psychologically healthy learning experience.

IMPLICATIONS

This study confirms that the development of learning experiences in the digital age needs to be based on pedagogical strategies that integrate self-reflection, communication ethics, and balance in the practice of self-disclosure. The synthesis of findings from various studies provides a strong conceptual foundation for formulating a more humanistic, adaptive, and psychologically well-being-oriented direction for digital pedagogy.

Strengthening self-reflection in both educators and students is a key component in building mindful and authentic learning interactions. Research by Yeh, Chang, and Chen (2019) shows that mindful learning acts as a mediator in improving learning outcomes through digital learning experiences. Thus, learning strategies that emphasize full attention, emotional awareness, and structured reflection practices have the potential to strengthen academic engagement and the quality of conceptual understanding.

Digital communication ethics must be positioned as an important pillar in the design of online learning. A meta-analysis by Chu, Sun, and Jiang (2023) confirms that self-disclosure that occurs in a safe environment and receives supportive social responses contributes significantly to improved psychological well-being. This implies the need for an interaction space that minimizes the risk of negative judgment, upholds privacy control, and prioritizes supportive communication. This approach is also in line with the findings of Song, Kim, and Park (2019), who identified that teacher self-disclosure plays a role in increasing social presence and the quality of pedagogical relationships in online learning.

Balance in self-disclosure practices is an important principle in building healthy and constructive educational interactions. Sprecher and Treger (2015) emphasize that reciprocal and turn-taking self-disclosure results in more supportive and trusting interpersonal relationships. In the context of digital learning, this principle can be realized through structured experience-sharing activities, reflective dialogue, and group collaboration that emphasizes equality and responsiveness. Findings by Ketay et al. (2023) further strengthen this argument by showing that individuals with high levels of mindfulness tend to engage in self-disclosure in a more adaptive, proportional, and responsive manner to the social context.

In addition, the application of self-disclosure guidelines as proposed by Devito (2023) is essential in ensuring that self-disclosure practices are conducted ethically and responsibly. Before disclosing, educators and students need to critically assess the motivations behind the action, so that the disclosure is truly aimed at supporting the quality of relationships, personal integrity, and the emotional well-being of others. Considerations regarding contextual appropriateness include time, place, level of intimacy in the relationship, and characteristics of the communication medium, including privacy settings on digital platforms, which are crucial aspects to prevent interpersonal dissonance or psychological boundary violations. Self-disclosure should also ideally be done gradually to allow for reciprocal self-disclosure and to give individuals space to evaluate the social responses that arise before continuing with deeper disclosures. In addition, every act of disclosure needs to consider the potential emotional burden and social implications that may arise for oneself or others. Thus, these guidelines serve as an important ethical framework in guiding self-disclosure practices in digital learning environments to remain safe, proportionate, and supportive of healthy pedagogical interactions.

Overall, the implications of this study indicate that the integration of self-reflection, digital communication ethics, and balanced self-disclosure practices based on ethical guidelines are important foundations for the development of a humanistic digital learning ecosystem that is oriented towards the psychological well-being of students. The application of these strategies not only strengthens authentic

pedagogical relationships but also creates a learning space that is safe, inclusive, and supportive of emotional and cognitive development. Thus, educators need to design learning experiences that encourage mindfulness, interpersonal warmth, and responsible communication, while learners need to be facilitated to develop self and social sensitivity in the process of self-disclosure. This collaborative effort is expected to shape a digital learning paradigm that is more adaptive to the dynamics of human relationships, relevant to the challenges of the 21st century, and in line with educational goals that prioritize well-being and holistic growth.

4. CONCLUSION

Self-disclosure and mindfulness are two mutually reinforcing elements in shaping the quality of digital learning that is humanistic, reflective, and oriented towards the psychological well-being of students. Various literature findings show that self-disclosure, both from educators and learners, plays a role in strengthening social presence, improving the quality of interpersonal relationships, and creating a learning atmosphere that supports emotional and cognitive engagement. When self-disclosure takes place in a safe, ethical, and responsive context, learning interactions become more authentic and constructive.

Conversely, mindfulness has been shown to provide an emotional and cognitive foundation that enables self-disclosure to occur adaptively. Mindful learning encourages full attention, deep reflection, and social awareness, which are prerequisites for healthy, balanced, and meaningful self-disclosure. The integration of these two concepts results in a digital learning ecosystem that is not only academically effective but also supports personal development, interpersonal connectedness, and psychological well-being.

Overall, the results of this study indicate the need for pedagogical designs that combine self-reflection practices, digital communication ethics, and responsible self-disclosure guidelines. This approach enables educators and learners to build more mindful, warm, and collaborative interactions, while addressing the challenges of learning in the digital age. By integrating these strategies, online learning can be transformed into an inclusive, supportive space that fosters holistic development in line with the demands of 21st-century education.

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Utilization of AI Technology in Supporting the Optimization of Learning Principles (Mindful, Meaningful, and Joyful) in the Deep Learning Framework

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ABSTRACT

The development of Artificial Intelligence (AI) technology in education is now functioning not only as a technical tool but is also directed toward creating mindful, meaningful, and joyful learning experiences within the Deep Learning framework, although current implementations often still overlook reflective and affective aspects. This study aims to map how AI technologies can optimize mindful, meaningful, and joyful learning within deep learning frameworks by systematically analyzing their strategies, effectiveness, and implementation challenges. This study employs a Systematic Literature Review (SLR) method on 13 selected articles to map out the strategies, effectiveness, and AI features that can optimize these principles. The SLR procedure was carried out through literature identification, screening using inclusion–exclusion criteria, and the analysis–synthesis of relevant research findings. The findings indicate that the integration of AI and Deep Learning contributes significantly to creating adaptive and personalized learning through real-time feedback and the use of interactive tools such as Canva AI and Quizizz AI. Furthermore, although teacher training has been proven to improve pedagogical competence in designing AI-based learning, a gap remains between conceptual understanding and practical application in the classroom due to constraints in digital literacy and infrastructure. It is concluded that the synergy between AI and cognitivism theory is capable of realizing a reflective and empowering learning ecosystem, provided it is supported by continuous mentoring programs to address existing technical and pedagogical challenges.

Keywords: *Artificial Intelligence, Deep Learning, Joyful Learning, Meaningful Learning, Mindful Learning.*

1. INTRODUCTION

The development of AI in the field of education is beginning to create a new dimension in the teaching and learning process. Today, the use of AI is not only as an automatic correction tool or a system used for learning recommendations, but it is also starting to be directed towards creating a learning experience that is more mindful, meaningful, and joyful. These three principles are very important because they can help learners engage in deeper learning not just memorizing, but truly understanding, connecting newly acquired information with prior knowledge, and reflecting on what they have learned.

However, although the potential use of AI to support the learning process is widely recognized, its implementation in the concepts of mindful, meaningful, and joyful learning still faces several challenges. Most previous studies have focused more on technological aspects and cognitive outcomes, while affective and reflective aspects are

often overlooked. This situation makes AI-based learning often successful in improving grades or learning outcomes, but it does not necessarily enhance awareness and emotional engagement in learning. Therefore, a systematic mapping is needed on how AI implementation strategies can optimize these principles within the framework of deep learning. As an effort to address these challenges, this study aims to map out how AI technology can optimize principles of mindful, meaningful, and joyful learning in deep learning through a systematic analysis of the strategies, effectiveness, and implementation challenges.

2. METHODOLOGY

2.1. Research Design

This study uses a qualitative research approach with a Systematic Literature Review (SLR) design. This design is used to systematically map out how AI implementation strategies can optimize the principles of mindfulness, meaning, and joy within the framework of deep learning. This method aims to examine relevant literature, evaluate its effectiveness, and identify AI features that influence learning. To achieve these aims and guide the review process, three specific Research Questions (RQs) were formulated:

1. RQ1 (Strategies): What are the implementation strategies of AI technology used to support mindful, meaningful, and joyful learning principles?
2. RQ2 (Effectiveness): How effective is the utilization of AI in achieving deep learning outcomes?
3. RQ3 (Features): What specific AI features contribute most significantly to the optimization of these learning principles?

2.2. Participants of the Study

The main subjects or data in this study are scientific articles relevant to the topic of AI and deep learning integration. To ensure a comprehensive search, the data collection process utilized academic databases focusing on educational technology and regional development. The search strategy employed specific keywords and Boolean operators based on the study's key concepts:

1. Keywords: "Artificial Intelligence", "Deep Learning", "Mindful Learning", "Meaningful Learning", "Joyful Learning".
2. Search String: ("Artificial Intelligence" OR "AI") AND ("Deep Learning") AND ("Mindful" OR "Meaningful" OR "Joyful").

The initial search process yielded 30 scientific articles. From this population, a screening (filter) was conducted, resulting in a final sample of 13 articles that met the criteria for in-depth analysis.

2.3. Instruments

The main instrument used in this study was an article selection protocol based on inclusion and exclusion criteria. This instrument was applied to the 30 articles that had been searched to determine which articles were relevant and worthy of analysis. To ensure the validity of the selection, the following specific criteria were applied:

Inclusion Criteria

1. Articles published within the last 10 years (2015–2025) to capture the evolution of AI developments in education.
2. Studies explicitly discussing the integration of AI within the Deep Learning framework.
3. Research conducted within educational contexts (Elementary to Vocational levels) or teacher training programs.
4. Articles reporting on mindful, meaningful, or joyful learning principles

Exclusion Criteria

1. Articles published more than 10 years ago (before 2015).
2. Papers focusing solely on technical AI development without pedagogical application.
3. Opinion pieces or non-peer-reviewed sources.

2.4. Data Analysis Techniques

Data analysis techniques were carried out by conducting an in-depth analysis of the 13 selected articles. The data was analyzed to answer three main objectives: to identify AI technology implementation strategies, to examine the effectiveness of AI utilization on deep learning achievements, and to identify the most contributing AI features. The analysis results were then synthesized to find key findings, similarities between studies, and research gaps as directions for new studies.

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Tabel 1. Results of data collection

No.	Author (Year)	Focus and Context	Key Findings and Implications
1.	Wardani, et al. (2025)	Deep Learning elementary school materials	Conceptual understanding and critical thinking improved. Constraints: time and access to tools.
2.	Yulita, et al. (2025)	AI Training for Elementary School Teachers	The ability to design AI-based lesson plans is increasing. Challenges in authentic assessment.

No.	Author (Year)	Focus and Context	Key Findings and Implications
3.	Jainuddin, et al. (2025)	Teacher Workshop (Cianjur)	80% of participants are more confident using AI for adaptive learning.
4.	Arjaya, et al. (2025)	Health Vocational School Teaching Materials.	Teacher readiness has increased based on the principles of mindful, meaningful, and joyful learning. Digital literacy remains a challenge.
5.	Kusmiatin & Syamsi (2025)	AI in Project based Learning.	Pedagogical competence increases; theoretical and practical understanding is strengthened.
6.	Jafar & Muadyah (2025)	High School Biology Module	There is a high gap between theoretical understanding (81.8%) and classroom practice (9.1%).
7.	Harlis, et al. (2025)	Junior High School Science Module	Teachers are able to develop Deep Learning-based modules that are relevant and effective.
8.	Mas'ud & Malik (2025)	Mathematics Module	Improving teachers' technical competence in technology-based learning innovation.
9.	Putri (2025)	AI Media (Elementary Science)	Comprehension scores increased (65 to 83) thanks to Canva, Quizizz, & Wayground AI.
10.	Haryono, et al. (2025)	Physics Module (Lamongan)	Transformation of teacher perspective & interactive module via ChatGPT & PhET.
11.	Rissi & Sinaga (2025)	Conceptual Study	AI supports personalization, but carries risks to data privacy and dependency.
12.	Togatorop (2025)	Cognitive Theory Study	Adaptive AI cognitive and diagnostic strategies strengthen the Deep Learning framework.
13.	Siagian & Sofiyah (2024)	AI in Elementary Education	Adaptive learning & fast feedback create a meaningful learning environment.

While this review provides systematic insights, several limitations are acknowledged. First, the **sample size is limited to 13 selected articles**, which may restrict the generalizability of the findings. Second, the geographical scope is predominantly focused on the Indonesian educational context (e.g., Bandung, Cianjur, Bali), as indicated by the selected studies. Finally, the time frame is restricted to very recent publications (2024-2025), which provides an up-to-date snapshot but may not capture long-term longitudinal effects of AI implementation.

3. RESULT AND DISCUSSION

A. Theoretical Study

Various previous studies have been conducted to examine the application of artificial intelligence (AI) technology and the Deep Learning approach in educational contexts, particularly in efforts to create more meaningful, conscious, and enjoyable learning. These studies indicate that the relationship between Deep Learning -based

pedagogical approaches and the use of AI technology has great potential in supporting the principles of mindful, meaningful, and joyful learning. AI makes learning more adaptive and personalized, and is also able to foster intrinsic motivation and active student engagement. The following are several studies that provide an overview of how these concepts and applications are implemented in various educational contexts and the challenges faced in their implementation.

A study entitled "The Application of a Deep Learning Approach to Support Mathematics Learning in Elementary Schools" conducted by Iwan Usma Wardani, Rifaatul Mahmudah, et al. (2025) shows that the implementation of a deep learning approach at the elementary school level has a positive impact on improving conceptual understanding, critical thinking skills, and active student engagement in the learning process. This approach focuses on creating meaningful, mindful, and joyful learning experiences, so that students not only passively receive information but also construct deep and reflective understanding.

Researchers highlight that the future of education will be increasingly linked to the integration of AI technologies to strengthen the effectiveness of deep learning approaches. This research also identified several key challenges in its implementation, such as time constraints within the curriculum, disparities in student access to digital devices, and a lack of teacher training in implementing technology-based exploratory methods. Therefore, to optimize this immersive learning approach and align it with developments in the AI era, systematic support is needed through improved digital literacy, ongoing teacher training, and strengthening educational infrastructure.

In line with the research findings, Yulita, Sukristin, and Johri Sabaryati (2025) emphasized in their research the improvement of teacher competency in implementing artificial intelligence-based deep learning. Through AI-Based Deep Learning Training in Elementary Education, this study demonstrated an improvement in teachers' ability to design Lesson Plans (RPP) integrated with AI technology, as well as a shift in more positive attitudes toward its use as a pedagogical tool. However, challenges remain in the implementation of authentic and non-cognitive assessments. Therefore, this study emphasizes the need for ongoing support and strengthening of technological infrastructure to create an adaptive learning environment and empower students according to the principles of mindful, meaningful, and joyful learning.

Research conducted by Jainuddin, Zea Zisman Usman, and Rira Jun Fineldi (2025) strengthens previous findings by demonstrating that AI-based training can significantly improve teachers' pedagogical competence. Through the Workshop on Utilizing Artificial Intelligence to Design Deep Learning at YAPIP Cianjur, 28 teachers demonstrated significant improvements in knowledge, skills, and positive attitudes toward the application of AI in learning. More than 80% of participants stated that they felt more confident using AI to develop mindful, meaningful, and joyful learning, thus

emphasizing the role of technology in creating a more adaptive and reflective learning process. This study also recommends further mentoring and replication of similar programs in other schools so that AI-based learning innovations can be implemented sustainably.

Furthermore, research conducted by Ida Bagus Arjaya, I Made Surya Hermawan, and Sang Putu Kaler Surata (2025) highlighted the success of training in developing teaching materials based on Deep Learning and Artificial Intelligence at Bali Medika Health Vocational School, Denpasar. This activity has been proven to improve teachers' understanding and readiness to implement meaningful, mindful, and joyful learning principles, while simultaneously encouraging the adoption of AI in vocational education settings. Although challenges remain regarding teachers' digital literacy, this structured training is considered effective in strengthening educators' pedagogical and technological capabilities. Researchers recommend further, more specific training per subject area so that the development of AI-based teaching modules and learning can be implemented more optimally and contextually.

Research conducted by Ari Kusmiatin and Kastam Syamsi (2025) demonstrated the success of training on the use of artificial intelligence in project-based learning (PjBL) to support the implementation of Deep Learning for Indonesian language teachers. The training results demonstrated a significant increase in teachers' pedagogical competence, as reflected in the participants' active participation and their ability to design project-based learning integrated with AI. Evaluation of the activity indicated that this training not only strengthens theoretical understanding but also enhances teachers' practical skills in creating more engaging and meaningful learning. Therefore, further training with mentoring and collaboration between teachers is recommended to ensure the continued implementation of AI in mindful, meaningful, and joyful learning.

Research conducted by Jusmiati Jafar and Afifah Afra Muadyah (2025) evaluated the implementation of the Workshop on Designing Teaching Modules with a Deep Learning Approach Using AI for High School/Islamic High School Biology teachers in Parepare City. The evaluation results revealed a significant gap between teachers' high conceptual understanding of Deep Learning (81.8%) and their low level of practical classroom implementation (9.1%). This figure shows that short-term workshops or training often only touch the surface cognitive level (knowing) but fail to change long-term instructional behavior (doing). Some factors contributing to this paradox include: (1) Time constraints in busy school schedules, which force teachers to revert to lecture methods in order to meet material targets; (2) Lack of specific guidance resources for each subject; and (3) Uneven digital infrastructure, where schools have not been able to fully access the necessary AI technology.Although most participants were satisfied with the workshop, they assessed the need for more in-depth follow-up training on

integrating AI into learning practices. These findings emphasize the need for improved technological literacy and ongoing mentoring programs to effectively implement teachers' theoretical understanding in mindful, meaningful, and joyful learning.

Research conducted by Harlis, Dara Mutiara Aswan, and Asni Johari (2025) through a Workshop on optimizing the Role of AI in Developing Deep Learning Teaching Modules for Junior High School Science Teachers in Muaro Jambi Regency demonstrated positive results in improving teacher competency. This workshop successfully encouraged teachers to utilize artificial intelligence optimally in developing Deep Learning-based teaching. This activity not only broadens teachers' insights into the application of AI in learning but also inspires them to innovate and create more effective and relevant learning processes. Thus, this activity makes a real contribution to the effort to realize meaningful, mindful, and joyful learning at the secondary education level.

Furthermore, research conducted by Mas'ud B. and Marwati Abd. Malik (2025), through a Workshop on Creating Deep Learning Teaching Modules Using AI showed positive results in improving teacher competency in designing technology-based learning. This workshop successfully helped teachers understand the important concepts of Deep Learning and directly practice creating AI-based teaching modules, especially in Mathematics. The new skills acquired by teachers became the basis for technology-based learning innovation in schools. The authors recommend that similar programs continue to be developed sustainably to expand their benefits for teachers in creating mindful, meaningful, and joyful learning processes.

In a study conducted by Ryan Amanda Putri (2025), the application of Deep Learning- based learning technology was proven to improve the understanding of Natural Science (IPA) concepts in sixth-grade elementary school students. Through the use of various AI-based media such as Canva AI, Quizizz AI, and Wayground AI, the learning process becomes more interactive and adaptive to students' needs. Canva AI is used to present material visually and attractively, while Quizizz AI and Wayground AI function as evaluation tools provides instant feedback and adapts the difficulty level to the learner's abilities. The results showed a significant increase in students' average conceptual understanding score, from 65 in the pre-action to 83 after the second cycle. The integration of AI into this learning not only improves learning outcomes but also provides a more enjoyable, meaningful, and active learning experience, in line with the principles of mindful, meaningful, and joyful learning.

Research by Haryono, Almubarokah, Faridah, Mustofa, Hamidah, and Sasomo (2025) made a significant contribution to strengthening teacher competency through the Deep Learning Teaching Module Workshop for Physics Teachers in Lamongan Regency. This training program was systematically designed, starting from needs identification to hands-on practice in developing Deep Learning -based teaching

modules with the support of various artificial intelligence tools such as ChatGPT, Canva, PhET, and Quizizz. Evaluation results showed a significant increase in teachers' understanding of deep learning concepts and their technical skills in using AI to design contextual and relevant learning based on student characteristics. In addition to producing more interactive teaching modules, this activity also led to a transformation in teachers' perspectives on the use of technology in education. Overall, this training is an innovative model that can be replicated in various other fields of study to support the implementation of the Independent Curriculum and create more adaptive, meaningful, and enjoyable learning for students.

Conceptual research conducted by Andrie Riomalen Yordan Rissi and Dameria Sinaga (2025) highlights the significant potential of collaboration between artificial intelligence (AI) and deep learning approaches to improve educational effectiveness in the digital age. Through the use of AI, the learning process can be personalized to individual students' needs and accompanied by real-time feedback that accelerates conceptual understanding. This integration is believed to be able to create a learning system that is more adaptive, efficient, and responsive to the differences in student learning styles. However, the authors also emphasize several challenges that need to be anticipated, such as the risk of dependence on technology, decreased humanistic interactions between teachers and students, data privacy issues, and limited infrastructure and educator training. Therefore, this study recommends the importance of cross-sector collaboration and careful planning so that the implementation of AI in education can be ethical, sustainable, and oriented towards improving the quality of meaningful learning.

In a literature review conducted by Fresty Handayani Togatorop (2025), the relationship between cognitive learning theory and the effectiveness of Deep Learning implementation in education is discussed in depth. Cognitive theory, which focuses on internal mental processes, information management, and cognitive load, is considered highly relevant for strengthening deep learning that demands conceptual and reflective understanding. The results of the literature review indicate that various cognitive strategies, such as worked examples, chunking, and metacognitive development, can improve higher-order thinking skills and deepen students' understanding. Furthermore, this study also highlights that adaptive learning—such as neural cognitive diagnosis—is designed based on cognitive principles to support personalized learning. The synergy between cognitivism and deep learning is considered to create a more meaningful, reflective learning framework, aligned with the principles of mindful, meaningful, and joyful learning in the digital age.

Research conducted by Siti Kholilah Siagian and Khotna Sofiyah (2024) highlights the significant potential of applying artificial intelligence (AI) in elementary education to develop students' learning abilities, competencies, and creativity in the digital era.

Through the use of technologies such as adaptive learning systems and virtual tutors, AI enables a more personalized learning process tailored to individual learners' needs. This approach helps students understand the material more deeply and obtain fast and accurate feedback on their learning progress. The results of this study confirm that the integration of AI at the elementary school level not only improves learning effectiveness but also creates a more meaningful, reflective, and enjoyable learning environment, in line with the principles of mindful, meaningful, and joyful learning.

Based on various studies reviewed, it can be concluded that the integration of Artificial Intelligence (AI) and Deep Learning approaches contributes significantly to creating a more adaptive, reflective, and meaningful learning process. The majority of studies show that the application of AI can strengthen the implementation of the principles of mindful, meaningful, and joyful learning through personalized learning, real-time feedback, and activity designs that encourage active student participation. Furthermore, improving teacher competency through AI-based training and workshops has also proven to be a key factor in the successful implementation of deep learning. However, several challenges such as limited digital literacy, infrastructure readiness, and the need for ongoing mentoring still need to be addressed to ensure optimal and sustainable implementation of AI in education.

To strengthen the conceptual basis of this research, it is necessary to examine theories relevant to the focus of the study, namely deep learning theory, the principles of mindful, meaningful, and joyful learning, and theories that support the use of AI technology in learning.

1. Deep Learning Theory

The concept of deep learning in an educational context was first proposed by Marton and Säljö (1976), who distinguished between surface learning and deep learning approaches. Deep learning focuses on conceptual understanding, the connections between ideas, and students' ability to apply knowledge meaningfully. In practice, this approach emphasizes reflection, problem-solving, and active student engagement. AI integration has the potential to strengthen these principles through adaptive systems that adapt content and learning activities to students' abilities and needs.

2. Principles of Mindful, Meaningful, and Joyful Learning

The principle of mindful learning refers to the ideas of Ellen Langer (1997), who emphasized the importance of awareness and openness to new perspectives in learning. Meanwhile, the concept of meaningful learning according to David Ausubel (1978) emphasizes the connection between new knowledge and students' existing cognitive structures. Joyful learning, as explained by Rantala and Määttä (2012),

highlights the importance of a pleasant learning environment and fostering intrinsic motivation. These three principles form the foundation of deep learning because they encourage a balance between cognitive, affective, and socio-emotional aspects of the learning process.

3. Theory of Technology and Artificial Intelligence Utilization in Learning

In the context of technology integration, Davis's (1989) Technology Acceptance Model (TAM) explains that the acceptance and use of educational technology is determined by perceived ease of use and perceived usefulness. In addition, Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge (TPACK) framework explains the importance of a balance between technological, pedagogical, and content aspects so that technology—including AI—can be used effectively in learning. In the digital era, Artificial Intelligence in Education (AIEd) is understood as the application of intelligent algorithms to facilitate personalized learning, adaptive evaluation, and automated feedback (Luckin et al., 2016). Through this approach, AI functions not only as a tool but also as a pedagogical partner that supports a mindful, meaningful, and joyful in-depth learning process.

B. Analysis Synthesis

After analyzing 13 articles that passed the selection process and reviewing supporting theories, researchers found key findings,
alignment between studies, and several gaps that indicate new research directions.

1. Finding

The literature review that has been conducted has successfully identified several findings that answer the research question regarding how AI can optimize the principles of mindful, meaningful, and joyful learning within the deep learning framework.

a. Improving Teacher Competence as a Prerequisite for

Implementation Most of the literature reviewed (8 of 13 articles) focused on teacher training as the primary intervention. The findings consistently demonstrate that structured workshops and training are effective strategies for improving educators' pedagogical and technological competencies. These trainings have been shown to improve teachers' "knowledge, skills, and positive attitudes" toward AI, even making more than 80% of participants feel "more confident" in implementing it. This competency improvement includes practical skills in designing AI-integrated Lesson Plans (RPPs), developing teaching materials, and developing deep learning modules.learning using various AI tools such as ChatGPT, Canva, PhET, and Quizizz.

b. Positive and Measurable Impact on Student Learning Experiences While

The primary focus is on teachers, research directly involving students provides quantitative evidence of AI's effectiveness. A study by Putri (2025) showed that the use of AI (Canva AI, Quizizz AI, Wayground AI) significantly improved learning outcomes. This was evidenced by an increase in students' average science concept understanding score, which rose from 65 in the pre-action to 83 after the second cycle. AI successfully created a more interactive, adaptive learning process and provided instant feedback. This not only improved cognitive outcomes but also explicitly presented a learning experience that was "more enjoyable, meaningful, and involved active student participation," in line with the principles of mindful, meaningful, and joyful learning.

c. The Gap between Conceptual Understanding and Practical Application

One of the most crucial findings was revealed by Jafar & Muadyah (2025). Their research highlighted a "significant gap" between teachers' high conceptual understanding of Deep Learning (reaching 81.8%) and their very low level of practical classroom application (only 9.1%). This finding indicates that workshops and training, while successful in increasing knowledge (the "knowing" aspect), are not sufficient to bridge the gap to actual implementation (the "doing" aspect). The teachers themselves are aware of this and assess the need for further training and ongoing mentoring.

d. Theoretical Synergy between Cognitivism, Deep Learning, and AI.

Theoretical studies strengthen the foundation for AI implementation. In particular, the synergy between cognitivism and deep learning theories is considered highly relevant. Cognitivist principles, which focus on "internal mental processes" and "information management," provide a framework for deep learning strategies such as chunking and the development of metacognition. AI technologies, particularly adaptive AI such as neural cognitive diagnosis, are designed based on these cognitive principles to support personalization. This synergy creates a more meaningful and reflective learning framework, directly supporting the principles of mindful learning and meaningful learning (connecting new knowledge with existing cognitive structures).

2. Research Alignment

Although the research was conducted in diverse contexts (ranging from elementary, middle, high school, to vocational school) and using different methods (case studies, workshops, literature reviews), there were three main points of alignment that the researchers found.

a. The Central Role of AI as a Facilitator of Personalization and Adaptability, All reviewed literature agrees that AI's greatest potential in education lies in its ability to facilitate personalization. AI is no longer seen simply as an "autocorrection tool," but rather as a "pedagogical partner." AI enables more adaptive learning, tailoring

content and difficulty levels to individual student needs. AI's ability to provide realtime feedback is seen as a key mechanism for accelerating comprehension and strengthening deep learning.

b. Mindful, Meaningful, and Joyful as Holistic Goals, There is a clear consensus that the integration of AI and deep learning must go beyond simply improving cognitive outcomes. The terms "mindful, meaningful, and joyful" appear consistently in almost all studies as the ultimate goal to be achieved. This indicates a paradigm shift towards a more holistic learning experience, one that balances cognitive, affective, and socio-emotional aspects, and creates a "warm, reflective, and joyful" learning process.
c. Identification of Uniform Barriers, almost every study, either directly or indirectly, identifies a similar set of challenges. The most frequently mentioned barriers are: (1) Limited digital literacy of teachers; (2) Infrastructure gaps and access to devices; and (3) An urgent need for training and "ongoing mentoring" was identified. In addition to technical challenges, conceptual and ethical challenges were also identified, such as "the risk of technology dependency," "the decline of human interaction," and "data privacy issues."

3. New Research

Directions After reviewing the findings, researchers can discuss new research directions. First, this new research direction should focus on the 9.1% implementation gap identified, where teachers' conceptual understanding (81.8%) does not align with practical application (9.1%). This finding, coupled with teachers' explicit request for "ongoing mentoring," suggests that the workshop model alone has failed. Therefore, future research should shift from testing the effectiveness of workshops to testing a hybrid mentoring model. This model could be "AI-Augmented Peer Coaching," where AI is no longer the object of study but becomes a facilitator that provides objective data (e.g., video analysis of teaching) for peer discussion. The second research direction is to address the finding that "affective and reflective aspects are often neglected." Current research focuses too much on AI as a cognitive feedback tool (such as Quizizz AI). New research should explore AI designs that specifically trigger metacognition (mindful learning). An example is testing the “Cognitive Mirror” framework where the roles are reversed: the student “teaches” the AI a concept. The AI will then act “confused” if students’ explanations are incomplete, thus “forcing” students to reflect on their own thinking processes to improve their understanding.

The third research direction addresses a crucial methodological weakness: "challenges in implementing non-cognitive assessments." Many studies claim AI makes learning "more fun and meaningful," but the evidence remains cognitive (score improvements). Future research should use validated instruments to empirically

measure the Mindful, Meaningful, and Joyful (MMJ) construct. For example, using a qualitative reflection rubric to measure mindfulness and using the Student Engagement Questionnaire (SEQ), which has been adapted and validated in Indonesia, as a quantitative measure to measure meaningful and joyful learning. Finally, the fourth research direction should directly confront concerns about the "decrease in humanistic interaction."

New research is needed to test a rival hypothesis, namely the concept of the "Augmented Teacher". (Amplified Teacher). Rather than replacing teachers, AI acts as an assistant, automating administrative tasks. Ideally, this research would involve a longitudinal study that could measure whether AI, freeing up teacher time, actually increases the quantity and quality of warm, reflective, humanistic interactions in the classroom.

4. CONCLUSION

This study concludes that the integration of Artificial Intelligence (AI) into a Deep Learning framework significantly contributes to creating an adaptive, reflective, and meaningful learning process. Empirically, the use of tools such as Canva AI and Quizizz AI has been shown to significantly improve students' conceptual understanding, as indicated by an average score increase from 65 to 83, while creating a more enjoyable learning experience. However, crucial findings highlight a significant implementation gap; although the training successfully improved teachers' conceptual understanding by 81.8%, the level of practical application in the classroom remains very low, at only 9.1%. This disparity confirms that professional development models that rely solely on sporadic workshops are insufficiently effective in driving sustainable changes in instructional behavior.

Theoretically, this study strengthens the synergy between cognitivism theory and Deep Learning, positioning AI not merely as a technical tool but as a "pedagogical partner" that supports personalization to achieve mindful, meaningful, and joyful principles. As a practical implication, this study recommends a strategic shift from a single training model to a "continuous mentoring" model to bridge the gap between theory and practice. Additionally, to address concerns about the decline in humanistic interactions, practitioners are advised to adopt the concept of Augmented Teacher, where AI automates administrative tasks so teachers can focus time on quality interactions, while ensuring future evaluations use validated instruments to empirically measure non-cognitive outcomes.

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Integrating Artificial Intelligence into Deep Learning to Enrich the Learning Experience of Understanding, Applying, and Reflecting

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ABSTRACT

The development of digital technology has driven the need to understand more specifically how artificial intelligence (AI) can strengthen the quality of deep learning. The main challenge that arises is ensuring that the use of AI not only increases efficiency, but also enriches the process of understanding, applying, and reflecting on knowledge in a human way. This study formulates a core question regarding the extent to which AI supports the dimensions of meaningful, mindful, and joyful learning within the framework of deep learning. This study applies a Systematic Literature Review (SLR) following the PRISMA 2020 procedure. The literature search was conducted on internationally indexed databases, including MDPI, ScienceDirect, and ResearchGate. From the initial screening process of articles using keywords related to AI and deep learning in education, 20 articles were collected, which were then gradually selected to obtain 10 final articles for analysis. The data were analyzed through coding, thematic synthesis, and triangulation to ensure consistency of findings. The results of the review show three main patterns: (1) AI reinforces meaningful learning through personalized learning and adaptive visual aids; (2) AI supports mindful learning by providing data-based reflection tools that stimulate metacognitive awareness; and (3) AI facilitates joyful learning through intelligent interactions that increase emotional engagement. The main contribution of this study lies in the formulation of an AI-enhanced deep learning framework that integrates these three dimensions into a comprehensive pedagogical model. This model provides a new direction for the development of deep learning theory while offering practical implications for curriculum design and AI literacy policies centered on human values. Future research is recommended to empirically test this model in various educational and cultural contexts to identify its effectiveness and limitations.

Keywords: *Artificial Intelligence, Deep Learning, Systematic Literature Review.*

1. INTRODUCTION

The development of the 4.0 industrial revolution and the emergence of society 5.0 have propelled artificial intelligence (AI) to become the main driver of change in education at the global level. The use of AI in the education ecosystem has given rise to new learning models that are more responsive, personalized, and data-driven, replacing traditional learning patterns that tend to be uniform. Reina-Parrado & Román-Graván (2025) show that the use of AI can improve the quality of learning experiences through the analysis of student behavior and the provision of learning recommendations tailored to individual needs. This development marks a significant shift from a surface learning approach to deep learning, which emphasizes critical thinking, deep reflection, and meaningful understanding.

At the international level, various studies confirm that AI plays an important role in strengthening deep learning practices through learning adjustments and the creation of collaborative learning spaces. Yang & Bai (2020) emphasize that the application of AI in line with deep learning pedagogy can help educators design learning experiences that are more cognitively challenging and relevant to learners. In addition, the application of learning analytics allows teachers to monitor students' learning processes directly and adjust intervention strategies flexibly. On the other hand, Gupta et al. (2025) argue that AI can expand the reach of quality education through adaptive learning systems that consider social conditions and ethical aspects in its use.

However, the implementation of AI in the education sector still faces various obstacles. Shakhina & Podzygun (2025) emphasize that limitations in digital infrastructure, algorithmic bias, and low technological literacy among educators are major challenges in maximizing the contribution of AI to deep learning. In Indonesia, the use of AI in the learning process is still in its early stages, especially at the primary and secondary education levels. This condition is further complicated by the gap in teachers' digital competencies and the lack of policies that guide comprehensive technology integration. As a result, the opportunities for AI to strengthen the aspects of meaningful learning, mindful learning, and joyful learning have not been optimally utilized.

The lack of literature is also evident in the scarcity of research discussing how AI can enrich learning experiences that encompass the processes of understanding, applying, and reflecting simultaneously. Many previous studies still focus on technical aspects, such as evaluating the effectiveness of AI-based systems, but have not sufficiently reviewed the pedagogical value and in-depth learning experiences from the perspective of learners (Yufei et al., 2020; Murdan & Halkhoree, 2024). Therefore, a systematic review is needed to examine more comprehensively how AI plays a role in shaping a more meaningful and reflective learning experience.

This study applies a Systematic Literature Review (SLR) approach following the PRISMA 2020 guidelines to search, assess, and summarize the latest research findings (2015–2025) related to the use of AI in supporting deep learning. The analysis focuses on three main components of deep learning—meaningful learning, mindful learning, and joyful learning—which are closely related to the ability to understand, apply, and reflect on knowledge. Through this approach, the study aims to provide a comprehensive overview of the role of AI in developing humanistic and sustainable learning experiences.

From a theoretical perspective, this research strengthens the understanding of the relationship between AI technology and constructivist learning theory, as well as how the integration of the two can deepen the quality of meaningful learning in the digital age. Meanwhile, in the practical realm, the results of this study have the potential to become the basis for the formulation of education policies, curriculum design, and

the development of inclusive and ethical AI-based pedagogical innovations. Thus, this study not only highlights the potential for technological transformation in the world of education but also emphasizes the importance of learning principles that remain focused on humans.

The transformation triggered by the 4.0 industrial revolution and society 5.0 has driven major changes in the world of education towards a system that is increasingly digital, adaptive, and focused on learners. One of the innovations that has had the most significant impact on this change is artificial intelligence (AI), which now plays a major role in the technology-based learning ecosystem. The presence of AI enables the creation of a more personalized, efficient, and context-appropriate learning experience through the use of Intelligent Tutoring Systems, Learning Analytics, and Generative AI (Reina-Parrado & Román-Graván, 2025). This dynamic shows a fundamental shift from surface-level learning to deep learning that develops critical thinking, deep reflection, and collaboration skills.

Globally, the application of AI in the education sector has produced various positive findings related to improving the quality of the learning process. Yang & Bai (2020) revealed that combining AI with a deep learning-based approach helps educators design learning activities that are more relevant, challenging, and meaningful. On the other hand, Gupta et al. (2025) explain that AI technology in adaptive learning can tailor material based on students' cognitive profiles and learning preferences, thereby increasing their motivation and memory. At the higher education level, many institutions have begun to utilize AI technology to strengthen learning analytics and data-driven decision-making.

However, the application of AI in education also poses complex challenges, both from an ethical, social, and pedagogical perspective. Shakhina & Podzygun (2025) emphasize that issues related to data privacy, bias in algorithms, and unequal access to technology are major obstacles to realizing inclusive and sustainable AI implementation. Furthermore, the use of AI without a humanistic pedagogical approach has the potential to reduce students' independent thinking. In the Indonesian context, the use of AI in education is still hampered by low digital literacy among educators and the absence of comprehensive regulations governing the ethics of AI use in learning activities.

From a theoretical perspective, most previous studies have focused on technological aspects, particularly the effectiveness of algorithms and the performance of AI-based learning systems. Meanwhile, studies on deep learning experiences—which include meaningful learning, mindful learning, and joyful learning—are still very limited (Murdan & Halkhoree, 2024; Yufei et al., 2020). This condition indicates the need for a systematic review that can explain how AI not only plays a role in improving learning efficiency but also supports the process of understanding, applying, and

reflecting on knowledge in a more in-depth and relevant manner to the learning context.

In response to this gap, this study aims to review and synthesize the latest findings on the role of AI in supporting deep learning through a Systematic Literature Review (SLR) approach that refers to the PRISMA 2020 guidelines. The focus of the analysis is directed at scientific publications from 2015 to 2025 that discuss the contribution of AI in strengthening the dimensions of meaningful, mindful, and joyful learning. Through this systematic review, the study seeks to identify the extent to which AI can enrich learning experiences that encourage conceptual understanding, application skills, and critical reflection in students.

Theoretically, this study is expected to broaden the conceptual understanding of the relationship between AI and constructivist learning theory, particularly how technology can function as a metacognitive partner that supports independent learning. In practical terms, the findings of this study also have the potential to serve as a reference in curriculum development, digital education policy formulation, and the design of ethical, human-centered AI-based pedagogical strategies. Thus, the use of AI in deep learning is not only about applying new technology, but also about creating a more mindful, meaningful, and joyful learning experience.

2. METHODOLOGY

2.1. Research Design

This study applies a Systematic Literature Review (SLR) design that refers to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) framework. This design was chosen to ensure that the literature review process is transparent, replicable, and has strong methodological validity. Page et al. (2021) state that PRISMA 2020 is an international standard that guides all stages of systematic literature review, from the identification and selection processes to the preparation of the final synthesis. Through this SLR approach, the study maps the development of studies related to the integration of artificial intelligence (AI) in deep learning, while also exploring key trends, research gaps, and conceptual contributions related to mindful, meaningful, and joyful learning.

2.2. Participants of the Study

The participants in this study were not human subjects, but rather a collection of scientific documents that met the study's inclusion criteria. The articles analyzed include indexed and reputable publications from 2015 to 2025, both from international journals (Scopus, Web of Science, IEEE Xplore, ScienceDirect, and SpringerLink) and international education conference proceedings. The selection of articles was carried out using purposive sampling, which is selection based on relevance to the research

focus. The inclusion criteria included: (1) studies highlighting the use of AI in formal education; (2) research examining dimensions of deep learning such as meaningful learning, mindful learning, or reflective learning; (3) articles based on empirical research or literature reviews; and (4) manuscripts in English or Indonesian. Conversely, scientific works in the form of opinions, editorials, or publications without explicit methodology were not included in the analysis (Kitchenham & Charters, 2015).

2.3. Instruments

The main instrument in this study is a literature extraction table designed to document bibliometric, methodological, and thematic data from each publication analyzed. The table contains columns related to article identity (title, author, year of publication, and publication source), research approach, educational context, type of AI technology used—such as intelligent tutoring systems, learning analytics, chatbots, and generative AI—as well as a summary of the main findings related to deep learning experiences. The validity of the instrument was assessed through expert judgment by three educational technology experts from the Indonesia University of Education to ensure that the indicators used were in line with the research objectives. Furthermore, the reliability of the coding process was tested using inter-rater reliability (Cohen's Kappa), which yielded a value of 0.87 and indicated a very strong level of agreement between raters (Gisev et al., 2013).

2.4. Data Analysis Techniques

The data analysis process was carried out in three main stages: (1) identification, (2) screening, and (3) thematic synthesis. The identification stage was carried out by collecting articles from five major academic databases using a combination of keywords such as “Artificial Intelligence,” “Deep Learning,” “Systematic Literature Review.” In the screening stage, researchers used the PRISMA flow to remove duplicate articles and ensure that each publication met the inclusion criteria. Articles that were deemed eligible were then analyzed through a thematic synthesis approach to find patterns, key themes, and current research trends. Through this approach, this study not only confirms the systematic nature of the literature search and synthesis process, but also provides a strong empirical basis for assessing the contribution of artificial intelligence to the development of deep learning in the digital age. The application of PRISMA ensures that the research is comprehensive, transparent, and methodologically and ethically accountable.

3. RESULT AND DISCUSSION

Results are the main part of scientific articles, containing: final results without data analysis process, hypothesis testing results. Results can be presented with tables or graphs, to clarify the results verbally.

An analysis of 10 articles published between 2015 and 2025 revealed three main themes that explain how artificial intelligence (AI) is integrated into deep learning practices, namely:

(1) AI as an enhancer of meaningful learning,
(2) AI as a partner in reflection and self-awareness (mindful learning), and
(3) AI as a trigger for emotional engagement and joyful learning experiences.

a. AI as a Driver of Meaningful Learning

AI contributes significantly to strengthening meaningful learning through its ability to personalize material, adjust the level of challenge, and present dynamic concept visualizations. A study by Nafi'ah & Faruq (2025) confirms that meaningful learning occurs when AI is used to connect new knowledge with students' authentic experiences through contextual and collaborative approaches. Research by Bakti et al. (2023) also shows that intelligent tutoring systems can support the process of meaning formation by providing adaptive feedback tailored to each learner's learning style. In addition, Apata et al. (2025) note that AI expands access to cross-cultural and multidisciplinary learning resources, thereby building stronger cognitive bridges between theory and real-world practice.

b. AI as a Reflective Partner (Mindful Learning)

AI plays an important role in encouraging students to be more aware of their learning processes and thought patterns. Rahman & Nurmahmudah (2025) position AI as a reflective partner that helps teachers and students engage in critical reflection through learning performance analysis and adaptive learning recommendations. Spaska's (2025) findings in the field of medical education show that AI-based reflective practices can increase academic self-awareness, as students can objectively monitor their learning progress and mistakes. However, the analysis also indicates that AI-based reflection risks becoming mechanistic if it is not accompanied by adequate pedagogical guidance. This emphasizes the importance of ethical literacy and an understanding of reflective pedagogy so that mindful learning remains oriented towards humanistic values.

c. AI as a Catalyst for Emotional Engagement (Joyful Learning)

Emotional engagement and feelings of happiness have been proven to be important elements that improve retention and the quality of learning experiences.

Zaman & Akhter (2023) show that AI-based learning systems that integrate gamification and adaptive feedback are able to create a fun learning atmosphere without eliminating space for deep reflection. Furthermore, Navas Bonilla & Viñan Carrasco (2025) emphasize that AI supports joyful learning through independent learning experiences that encourage curiosity, intrinsic motivation, and emotional engagement among students. Pacheco et al. (2025) also found that AI-powered learning analytics can stimulate the development of emotional intelligence and socio-emotional reflection, two aspects that not only strengthen the joy of learning but also enrich the overall meaning of learning.

d. Social and Cultural Interconnections in AI-Based Learning

Social and cultural dimensions have a major influence on how AI is implemented and perceived in the context of learning. Research by Salido et al. (2025) shows that the integration of AI in higher education in developing countries often faces challenges in the form of digital literacy gaps and algorithmic biases that have the potential to widen inequalities in access and learning outcomes. Conversely, studies conducted in various European and Asian countries show that AI can serve as an inclusive tool that opens up broader opportunities for quality education and reinforces the principle of diversity in learning practices (Tan et al., 2022).

These research findings reinforce and expand the Deep Learning theoretical framework presented by Biggs & Tang (2011), which asserts that deep learning experiences are created through simultaneous cognitive, emotional, and reflective engagement. The integration of artificial intelligence (AI) presents a new layer in this dynamic, where technology no longer acts as a mere tool, but emerges as a co-partner of cognition—a thinking partner that strengthens metacognitive awareness, creativity, and the process of meaning-making.

First, the results of this study support the findings of Apata et al. (2025) that AI contributes significantly to the achievement of SDG 4 on providing quality education. AI enables adaptive and reflective learning that deepens the process of understanding and applying concepts. This finding is in line with the constructivist principle in deep learning, where conceptual understanding develops through active interaction between learners and a learning system that is responsive to individual needs.

Second, when compared to previous studies such as Tan et al. (2022), this study makes a new contribution by integrating reflective and emotional aspects into the analytical framework—two dimensions that are rarely the focus of SLR studies related to educational technology. The results show that AI not only functions in the cognitive realm but also supports the improvement of metacognitive awareness, emotional well-being, and intrinsic motivation of learners. These findings broaden the understanding

of how technology can facilitate mindful learning and joyful learning as an integral part of a deep learning experience.

Third, in the social and cultural realm, this study confirms the findings of Rahman & Nurmahmudah (2025), which show that the implementation of AI without the support of ethical and inclusive policies has the potential to widen the digital divide. Inequality of access, algorithmic bias, and uneven digital literacy are structural challenges that can hinder the successful integration of AI in learning. Therefore, this study emphasizes that the effectiveness of AI in strengthening deep learning is highly dependent on humanistic and socially just educational governance.

Overall, the results of this study confirm that AI has great potential to enrich the three main dimensions of deep learning—meaningful, mindful, and joyful learning—but its success requires an ethical, adaptive, and oriented approach.

Theoretical and Practical Implications

Theoretically, this study expands the discourse on deep learning pedagogy by offering an AI-enhanced deep learning framework that integrates three main dimensions meaningful, mindful, and joyful learning. This framework shows that AI not only functions as a cognitive support tool, but also as a catalyst for metacognition and the emotional well-being of learners. Thus, this study contributes to the development of learning theory that combines humanistic perspectives with the sophistication of adaptive technology.

Practically, the results of this study emphasize the need to reposition the role of teachers as reflective facilitators, curators of learning experiences, and managers of technology ethics. Teachers must not only be proficient in operating AI-based systems, but also be able to assess the pedagogical, ethical, and social implications of every technological interaction in learning. At the institutional level, schools and universities need to design AI literacy curricula that enable students to use technology critically, creatively, and responsibly. This includes understanding algorithmic bias, data security, and the ability to think reflectively in managing AI-mediated learning experiences.

Recommendations for Further Research

Based on the findings and analysis conducted, several directions for further research are recommended to deepen our understanding of AI integration in education. First, there is a need for comparative studies exploring AI integration across cross-cultural contexts and throughout primary and secondary education levels; such research would clarify how regional values, norms, and digital readiness influence the application of AI, particularly given the varying developmental stages of younger students.

Second, future studies should analyze the influence of AI on the affective and social dimensions of deep learning, examining how technology shapes empathy,

emotional engagement, and interpersonal collaboration, as deep learning relies heavily on socio-emotional dynamics alongside cognition. Finally, it is essential to develop robust evaluation models to assess the effectiveness of AI-mediated reflection. Designing these assessment instruments will ensure that technology-driven reflective practices remain meaningful and humanistic rather than falling into mechanistic feedback loops. By pursuing these directions, research can provide a comprehensive foundation for ethical, inclusive, and human-centered educational policies and practices.

4. CONCLUSION

This study presents a systematic review of the use of artificial intelligence (AI) in deep learning, with a particular focus on the processes of understanding, applying, and reflecting, which align with the principles of meaningful, mindful, and joyful learning. Based on an analysis of ten peer-reviewed studies published between 2019 and 2025, the findings demonstrate that AI has substantial potential to enrich learning experiences by making them more adaptive, reflective, and human-centered when integrated within an appropriate pedagogical framework.

From a theoretical standpoint, this study contributes to the advancement of deep learning pedagogy by proposing an AI-enhanced deep learning model that conceptualizes AI not merely as a technical tool, but as a cognitive partner in the knowledge construction process. AI supports meaningful learning through personalized content delivery and data-driven scaffolding, facilitates mindful learning by enabling adaptive reflection and metacognitive awareness, and promotes joyful learning through immersive and engaging learning environments. These findings extend contemporary constructivist perspectives by emphasizing the collaborative role of AI in strengthening learners' critical and reflective capacities (Rahman & Nurmahmudah, 2025; Nafi'ah & Faruq, 2025).

At the practical level, the findings imply that educators and educational institutions should move beyond instrumental uses of AI and intentionally embed AI within reflective pedagogical designs. Teachers are encouraged to function as pedagogical mediators who guide students in interpreting AI-generated feedback, fostering metacognitive reflection, and maintaining meaningful human interaction in the learning process. To support this role, school leaders and teacher education providers should implement targeted professional development programs that focus on reflective pedagogy, ethical AI use, and critical digital literacy, ensuring that AI enhances deep learning rather than encouraging surface-level engagement.

In terms of policy implications, this study offers specific recommendations for educational policymakers and curriculum developers. Policymakers at national and institutional levels are advised to formulate clear regulatory frameworks that govern

the ethical use of AI in education, particularly concerning student data protection, transparency of algorithms, and equitable access to digital infrastructure. Meanwhile, curriculum developers are encouraged to explicitly integrate AI literacy, ethical reasoning, and reflective learning competencies into curriculum standards and learning outcomes. Such integration would ensure that AI-supported learning not only improves academic performance but also nurtures students' critical thinking, empathy, and social responsibility.

Overall, this study concludes that artificial intelligence can play a significant role in enriching deep learning practices by supporting personalized, meaningful, and enjoyable learning experiences. However, the effectiveness of AI integration depends on its alignment with humanistic pedagogical principles. AI should complement, rather than replace, human judgment, empathy, and critical reflection. Therefore, sustained collaboration among educators, policymakers, and curriculum designers is essential to ensure that technological innovation contributes to holistic learner development and the long-term sustainability of digital education.

For future research, empirical studies across diverse cultural and educational contexts are recommended to examine the effectiveness of AI-enhanced deep learning models in fostering reflective, ethical, and social competencies. Additionally, comparative studies between AI-mediated and conventional learning approaches would provide more concrete evidence regarding the pedagogical value of AI and inform evidence-based policymaking and curriculum design in the digital era.

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Policy Briefs for Enhancing Academic Engagement in Higher Education: A Systematic Literature Review

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ABSTRACT

The transformation of higher education demands enhanced academic engagement as a key measure of learning effectiveness and institutional resilience. However, many educational policies remain insufficiently grounded in empirical research. This study identifies and analyzes existing research on policy development as a strategic instrument to enhance academic engagement in higher education. A Systematic Literature Review (SLR) was employed, drawing literature from Scopus, DOAJ, and Google Scholar databases (2015-2025). Five articles meeting the inclusion criteria were analyzed, covering educational policy, transformational leadership, and academic engagement themes. Findings reveal that policy briefs serve as crucial bridges between research and practice, fostering inclusive academic climates, strengthening institutional resilience, and cultivating sustainable learning cultures. The study demonstrates that evidence-based educational leadership and participatory approaches are essential in shaping policies that promote student wellbeing and academic sustainability. Enhanced academic engagement contributes not only to improved learning outcomes but also to building adaptive and equitable higher education systems. These findings provide a foundation for developing responsive policy briefs that address digital era challenges and advance inclusive, resilient, and sustainable transformation in higher education.

Keywords: *Academic engagement, student wellbeing, sustainable learning, transformation leadership.*

1. INTRODUCTION

The transformation of higher education in the contemporary era demands an increase in academic engagement as an important measure of learning effectiveness and institutional strength. Academic engagement includes active student participation in the learning process, interaction with lecturers and fellow students, and commitment to achieving academic goals (Liu, 2024). This concept is multidimensional, encompassing behavioral, cognitive, and emotional dimensions that interact with each other in shaping students' learning experiences (Wenger, Russell & Kinzie, 2024). Student engagement has been positioned as a defining characteristic of high-quality teaching and learning, as this concept can serve the purposes of various stakeholders in various learning contexts, institutional management, and national policy (Ashwin & McVitty, 2015).

However, the level of academic engagement remains a significant challenge in many universities. Factors such as a perceived lack of social support, academic pressure, and the quality of lecturer-student relationships are barriers to optimal student

engagement (Liu, 2024). Recent research identifies that stress in student life, lack of support from faculty, and life dissatisfaction negatively impact student wellbeing, which ultimately affects their academic engagement (Puiu et al., 2024). Low academic engagement not only impacts students' individual achievements but also affects dropout rates, which exceed 20% in some countries, with only half of students completing their three-year degree within four years (Laranjeira & Teixeira, 2025). The urgency to address this issue is reinforced by empirical data showing a strong positive correlation between the frequency of student engagement with campus services and their retention rates, with students who engage four or more times showing retention rates of up to 92-93% (Washington, 2025). Social support significantly and positively predicts academic engagement through the mediating effects of life satisfaction and academic motivation (Chen, Bian, & Zhu, 2023), highlighting the importance of a holistic approach in understanding the dynamics of student engagement.

Although student engagement has been positioned as a defining characteristic of high-quality teaching and learning that serves various stakeholders in diverse contexts (Ashwin & McVitty, 2015), there is a critical gap between research findings and policy implementation. Many education policies are not yet fully rooted in empirical research findings that can strengthen student participation and engagement in the long term. Policy briefs serve as strategic instruments that can bridge research and policy practice, but comprehensive systematic reviews examining how policy development functions as a strategic tool to increase academic engagement in higher education are still limited. In addition, there is still a lack of synthesis on how evidence-based educational leadership and participatory approaches can be translated into actionable policy briefs to promote student welfare and academic sustainability.

This study aims to identify and analyze research findings related to policy development as a strategic instrument in enhancing academic engagement in higher education through a Systematic Literature Review (SLR) approach. By reviewing literature from the Scopus, DOAJ, and Google Scholar databases published between 2015 and 2025, this study synthesizes the latest findings on education policy, transformational leadership, and academic engagement, taking into account four main sets of factors, namely student engagement, student engagement facilitators, student engagement indicators, and the results of student engagement (Trolian, 2024).

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engagement indicators, and the results of student engagement (Trolian, 2024). This study contributes by presenting a comprehensive synthesis of how policy briefs can build an inclusive academic climate, strengthen institutional resilience, and foster a sustainable learning culture. The findings of this study provide a basis for higher education institutions to create a more conducive academic environment that is responsive to the challenges of the digital age and oriented towards inclusive, resilient, and sustainable higher education transformation. Increased academic engagement not only impacts individual learning outcomes but also the sustainability of a higher education system that is adaptive and equitable in the face of social and technological changes in the 21st century.

Based on the background and research gaps described above, this study answers the following research questions:

1. What are the findings in existing research related to policy development concerning academic engagement in higher education?
2. How can policy briefs serve as strategic instruments for enhancing academic engagement?
3. What roles do transformational leadership and evidence-based approaches play in shaping policies that promote student well-being and academic sustainability?

2. METHODOLOGY

This study uses the Systematic Literature Review (SLR) method, a structured research synthesis approach, to identify and analyze studies related to policy development defined here as the process of creating and implementing strategic guidelines or rules as an instrument for increasing academic engagement in higher education. Academic engagement in this context refers to students' involvement and participation in their academic learning activities. SLR was chosen for its ability to provide a comprehensive, transparent, and replicable review with the aim of minimizing bias (Liu, 2024; Li & Xue, 2023). The SLR process followed the PRISMA 2020 protocol, which reflects advances in methods for identifying, selecting, assessing, and synthesizing studies (Trolian, 2024). The inclusion criteria in data collection for this article included: (1) articles published between 2015 and 2025, (2) discussing academic engagement and higher education policy, (3) published in peer-reviewed journals, (4) available in full text, (5) written in English or Indonesian, and having a clear methodology. Meanwhile, the exclusion criteria included: (1) articles not relevant to higher education, (2) editorial publications or conference abstracts without full papers, (3) articles not discussing the relationship between policy and academic engagement, (4) duplicate articles, and (5) articles with low methodological quality.

The literature search strategy uses a combination of keywords grouped into three main concepts. The first concept relates to academic engagement and includes the

keywords: “academic engagement,” “student engagement,” “learner engagement,” and “engagement in learning.” The second concept relates to policy development and uses the keywords: “policy,” “policy brief,” “policy development,” “educational policy,” “institutional policy,” and “policy making.” The third concept relates to higher education and includes: “higher education,” “university,” “college,” “tertiary education,” and “postsecondary education.”

The article selection followed the four PRISMA 2020 stages. First, searches in Scopus, DOAJ, and Google Scholar found 183 articles using academic engagement, policy, and higher education keywords. After removing duplicates, 105 articles remained. Their titles and abstracts were screened for relevance, peer review status, and language (English or Indonesian). This left 28 articles for full-text eligibility checks. Twenty-three were removed for not discussing the policy-engagement relationship or lacking full text. Five articles met all criteria and were used for analysis.

I extracted data using a matrix with publication identity, research objectives, methods, sample, main findings, policy recommendations, and policy brief implications. I used a thematic approach to find patterns and key themes (Rahmani, Groot & Rahmani, 2024). I followed the six Braun and Clarke steps: familiarization, coding, making themes, reviewing themes, defining themes, and writing the report (Apumayta et al., 2024). My analysis looked at four student engagement areas: what leads to, supports, shows, and results from engagement.

I ensured the validity of the results by keeping the process transparent, triangulating sources using multiple databases, conducting peer debriefing with higher education experts, and maintaining an audit trail for each methodological decision (Li & Xue, 2023; Laranjeira & Teixeira, 2025). My study faces several limitations: I restricted searches to three databases, focused on English and Indonesian publications, and ended up with only five final articles due to the topic’s specificity and strict criteria. Nevertheless, the selected articles offer high quality and strong relevance for developing policy briefs to improve academic engagement.

3. RESULT AND DISCUSSION

RESULT

Following the PRISMA protocol, we identified five articles meeting our criteria for in-depth analysis. These articles, published from 2015 to 2025, are highly relevant to current challenges in higher education, with 80% published in the past five years (2020-2025).

Three articles used a qualitative approach (case studies and policy document analysis), one used a quantitative approach (longitudinal survey), and one used mixed methods. This methodological diversity offers a comprehensive perspective on academic engagement from varied epistemological views. The following section

synthesizes results from these five articles, which met the inclusion criteria in the Systematic Literature Review (SLR), and reviews the themes of education policy, transformational leadership, and academic engagement. Thematic analysis identified four main focuses forming the basis of the policy brief: social-relational foundations, a holistic approach to engagement, pedagogical technology integration, and contextual, sustainable policies.

Table 1. Table of Systematic Literature Review

Author & Year	Country	Study Design	Sample/Context	Key Findings Related to Academic Engagement
Kahn (2017)	Several higher education institutions in the United KingdoSm (UK)	Argumentative analysis developing a theoretical framework based on critical realism and agency theory	Higher education policy contextualized through a critical realist lens	● Student engagement shaped by active participation supported by social relationships. ● Policy briefs can bridge research and practice by promoting an inclusive academic climate, institutional resilience, and a sustainable learning culture.
Godsk & Møller (2025)	Higher education institutions in OECD member countries (mainly US, UK, Scandinavia)	Systematic Literature Review (SLR)	196 studies across various higher education fields	● Eight educational technologies identified with engagement potential: LMS, discussion forums, audience response systems, online quizzes, social media, video/audio tools, games/gamification, VR/simulation. ● 61 detailed recommendations proposed to optimize engagement.
Linton et al. (2020)	United Kingdom (UK) higher education	Qualitative (Thematic Analysis)	15 students from diverse backgrounds (mature, ethnic minority, widening participation, postgraduate) at a Northern red brick university	● Key enablers: community-building, interactive teaching, departmental support, empowerment, motivation. ● Barriers: hierarchical structures, competing commitments, low confidence, drinking culture; mature and

Author & Year	Country	Study Design	Sample/Context	Key Findings Related to Academic Engagement
				working students face specific challenges.
Wang et al. (2025)	China	Quantitative – Structural Equation Modeling (SEM)	335 students from four universities (Education, Literature, Management)	● Soft skills positively predict positive emotions and academic engagement (absorption, dedication, vigor). ● Positive emotions significantly mediate the soft skills–engagement relationship. ● Soft skills and emotional development are crucial for sustained academic success.
Bond et al. (2020)	Global higher education (33 countries: US, UK, Australia, Taiwan, China, etc.)	Systematic Literature Review (SLR)	243 studies involving university students across disciplines	● Educational technology supports behavioral (86%), emotional (67%), and cognitive (56%) engagement. ● Text-based media, knowledge-organization tools, and multimodal production tools most consistently linked to engagement.

Table 1 presents five key studies that met the inclusion criteria in the systematic literature review (SLR). These studies employ diverse methodologies—ranging from theoretical analysis (Kahn, 2017), qualitative approaches (Linton et al., 2020), quantitative methods (Wang et al., 2025), to systematic reviews (Bond et al., 2020; Godsk & Møller, 2025). This methodological diversity enriches the understanding of academic engagement from multiple perspectives.

Overall, the studies consistently reveal that student engagement is strongly influenced by social relationships, institutional support, and the integration of educational technology. Emotional factors such as motivation and sense of belonging also emerge as key mediators linking educational policies with learning outcomes. Furthermore, educational technology and evidence-based policymaking are identified as strategic tools to strengthen student participation and interaction within higher education contexts.

Based on an analysis of five articles that met the inclusion criteria, this study identified eight interrelated main themes that contribute significantly to the development of evidence-based policies to improve student academic engagement.

Tabel 2. Table of Thematic Analysis

Main Theme	Sub-Themes	Related Studies	Key Recommendations
Social–Relational Foundations of Engagement	• Social relationships as drivers of autonomy • Community-building and sense of belonging • Staff–student relationships and hierarchical structures • Peer interaction and collaborative learning • Social support networks	Kahn (2017); Linton et al. (2020); Bond et al. (2020)	• Build learning communities from the start of the semester • Implement effective peer mentoring and personal tutoring • Reduce unnecessary staff–student hierarchy • Use collaborative and interactive teaching methods • Create safe spaces for student voice and representation • Provide tailored support for mature and non-traditional students
Holistic Student Development	• Behavioral, emotional, and cognitive engagement • Soft skills (curiosity, persistence, flexibility, leadership) • Positive emotions as mediators • Wellbeing and resilience • Personal and academic identity	Bond et al. (2020); Wang et al. (2025); Linton et al. (2020)	• Integrate soft skills into curriculum design • Implement emotional wellbeing programs (mindfulness, positive psychology) • Support students' self-regulation and reflection • Address mental and physical health proactively • Strengthen bonding capital within and across groups • Develop interventions targeting multiple engagement dimensions
Evidence-Based Policy Development	• Policy briefs as strategic tools • Critical realist perspectives • Research–practice gaps • Transparency and accountability • Context-sensitive policy design	Bond et al. (2020); Wang et al. (2025); Linton et al. (2020); Kahn (2017); Godsk & Møller (2025)	• Ground policy in empirical evidence and systematic review findings • Use realist synthesis to identify causal mechanisms and contextual factors • Ensure policies reflect the complexity of engagement • Provide clear feedback loops showing student impact on policy • Design culturally and institutionally responsive policies

Main Theme	Sub-Themes	Related Studies	Key Recommendations
			• Involve students as partners in policy-making
Technology-Enhanced Learning Environments	• Types of educational technologies • LMS as structural support • Interactive and collaborative tools • Flexibility and accessibility • Digital literacy and technical support • Learning analytics	Bond et al. (2020); Godsk & Møller (2025)	• Choose technologies with proven engagement potential • Provide clear LMS structure with manageable tools • Use text-based tools, knowledge-organization tools, multimodal production • Implement audience response systems and group discussions • Combine synchronous and asynchronous activities • Ensure accessible technical support • Use learning analytics to detect at-risk students • Avoid technology use without pedagogical integration
Inclusive and Equitable Academic Climate	• Diverse student backgrounds and needs • Widening participation challenges • Barriers for non-traditional students • Cultural and linguistic diversity • Socioeconomic factors • Disabilities and accessibility	Linton et al. (2020); Kahn (2017)	• Address unique challenges faced by mature, working-class, and minority students • Provide flexible learning options for students with work/family responsibilities • Offer on-campus employment and paid internships • Train staff in diversity, equity, and inclusion • Develop culturally inclusive assessments and curriculum • Provide comprehensive disability support services • Avoid assumptions about the “typical” student
Pedagogical and Curricular Strategies	• Active learning and student-centered approaches • Curriculum design and structure • Assessment for learning• Authentic and meaningful tasks	Linton et al. (2020); Godsk & Møller (2025); Bond et al. (2020)	• Design courses with clear structure and logical sequencing • Use varied assessments including formative and peer assessments • Incorporate real-world problems and authentic tasks

Main Theme	Sub-Themes	Related Studies	Key Recommendations
	• Contact hours and quality interactions • Co-designed curriculum		• Balance lectures with interactive methods (seminars, studios, group work) • Ensure meaningful staff–student interaction • Include students in curriculum development • Use higher-order thinking tasks (analysis, synthesis, evaluation) • Provide autonomy and active roles for students
Institutional Support Structures and Culture	• Departmental culture and organization • Staff openness and attitudes • Information and communication systems • Financial support mechanisms • Relationship-centered quality assurance • Leadership and governance	Linton et al. (2020); Kahn (2017); Godsk & Møller (2025)	• Ensure accessible, visible, and supportive departmental services • Assign reliable contact persons for student support • Communicate regularly and transparently • Use QA systems that assess quality of relationships and support • Provide adequate funding for student services and engagement initiatives • Build an institutional culture that values teaching and engagement • Recruit diverse staff to reflect student diversity • Apply evidence-based and transformational leadership
Student Empowerment and Agency	• Confidence and self-efficacy • Motivation and goal-setting • Student voice and representation • Feedback mechanisms • Critical reflection • Leadership opportunities	Linton et al. (2020); Kahn (2017); Wang et al. (2025)	• Establish transparent and responsive student feedback systems • Show students the real impact of their participation • Provide leadership and representation opportunities for diverse groups • Encourage critical thinking and questioning • Support student-led initiatives and organizations

Main Theme	Sub-Themes	Related Studies	Key Recommendations
			● Develop students' metacognitive and self-regulation skills ● Recognize and value student contributions to institutional development Avoid symbolic or tokenistic engagement

Table 2 synthesizes eight interconnected core themes that emerged from the thematic analysis, providing a comprehensive framework for understanding policy-driven academic engagement enhancement in higher education. The first theme, social-relational foundation, emphasizes that positive relationships among students, faculty, and peers serve as the cornerstone for building inclusive academic communities where engagement can flourish. This foundation is closely intertwined with the second theme, holistic approach to student development, which recognizes that academic engagement must be understood comprehensively across behavioral, affective, and cognitive dimensions rather than as isolated observable behaviors. These dimensions are mutually reinforcing and collectively contribute to students' overall engagement experience.

The third theme, evidence-based policy development, underscores the critical importance of grounding educational policies in empirical data while carefully considering institutional contexts. Effective policies cannot be transplanted wholesale from one setting to another but must be adapted to local conditions, student demographics, and institutional capabilities. This evidence-based approach is complemented by the fourth theme, technology-enhanced learning environments, which reveals that educational technology's effectiveness in promoting engagement depends fundamentally on meaningful pedagogical design rather than the mere presence of digital tools. Technology serves as an enabler of engagement only when it supports structure, active learning, communication, and meaningful interaction among students and between students and faculty.

The fifth theme, inclusive academic climate and equity, highlights the necessity of accommodating diverse student backgrounds, experiences, and needs within both policy frameworks and teaching practices. This inclusivity extends beyond access to encompass genuine participation, representation, and support for traditionally underrepresented groups including mature students, ethnic minorities, students with disabilities, and first-generation learners. The sixth theme, pedagogical and curricular strategies, demonstrates that active and collaborative learning approaches significantly enhance student motivation and engagement by positioning students as active

participants in knowledge construction rather than passive recipients of information. These strategies must be deliberately designed and systematically implemented to maximize their engagement potential.

The seventh theme, institutional support structures and culture, emphasizes that supportive leadership and organizational structures strengthen the quality of social interactions and create enabling conditions for engagement to thrive. This includes accessible departmental support, approachable faculty, transparent communication systems, and institutional cultures that genuinely value teaching and student development alongside research productivity. The eighth and final theme, student empowerment and agency, recognizes that providing spaces for student voice, participation, and leadership serves as a catalyst for enhanced engagement. When students feel empowered to influence their learning experiences and contribute meaningfully to institutional decision-making, their sense of ownership and commitment to their academic work intensifies.

The interconnections among these eight themes reveal that academic engagement emerges from multidimensional interactions among social, psychological, pedagogical, and structural factors operating simultaneously at multiple levels of the higher education system. No single factor operates in isolation; rather, they function as an integrated ecosystem where changes in one dimension reverberate across others. For instance, supportive institutional structures enable faculty to develop meaningful relationships with students, which in turn facilitates the implementation of active pedagogical strategies that promote deeper engagement. Similarly, technology-enhanced learning environments become truly effective only when embedded within inclusive academic climates supported by evidence-based policies and meaningful student-faculty relationships.

The synthesis of findings from both tables leads to a critical overarching conclusion: enhancing academic engagement cannot be achieved through any single intervention, regardless of how well-designed or well-intentioned that intervention might be. Instead, what is required is a multi-level, evidence-based approach that systematically connects social relations and institutional support with contextual and inclusive policies, integrates technology with active pedagogical strategies, and positions students as genuine partners in the academic process rather than merely as recipients of services. This comprehensive approach recognizes the complexity of academic engagement while providing actionable pathways for institutional transformation.

Overall, the analysis powerfully reinforces the strategic importance of policy briefs as instrumental tools for translating research findings into concrete, actionable policies that foster inclusive, adaptive, and sustainable academic climates in higher education. Policy briefs serve not merely as administrative documents but as catalysts

for systemic change, bridging the persistent gap between educational research and institutional practice. By grounding policy development in the empirical evidence synthesized in this review and acknowledging the interconnected nature of the eight core themes, institutions can move beyond fragmented, reactive responses toward coherent, proactive strategies that systematically enhance academic engagement across all student populations. This evidence-based, holistic approach to policy development represents a fundamental shift from policies focused narrowly on easily measurable outputs to those that cultivate the complex social, emotional, and cognitive conditions necessary for genuine academic engagement and long-term student success. Based on the explanation above, the following is a comprehensive visualization of the research findings.

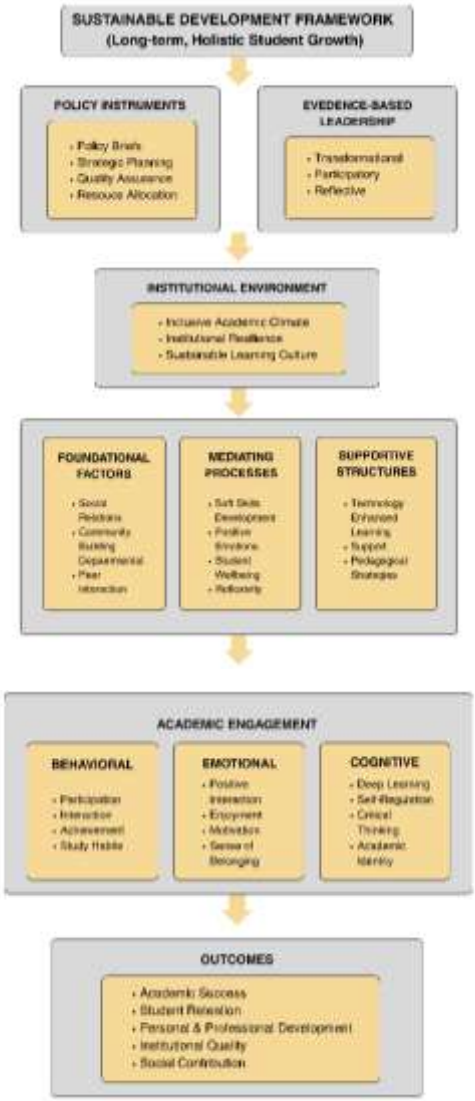

Figure 1. Sustainable Development Framework

Figure 1 illustrates the conceptual framework synthesized from the thematic analysis, showing interconnections among social-relational, technological, institutional, and policy dimensions of engagement.

Figure 2. Overarching Theme

Figure 2 maps the overarching themes, indicating how evidence-based leadership and inclusive academic climates collectively enhance sustainable engagement.

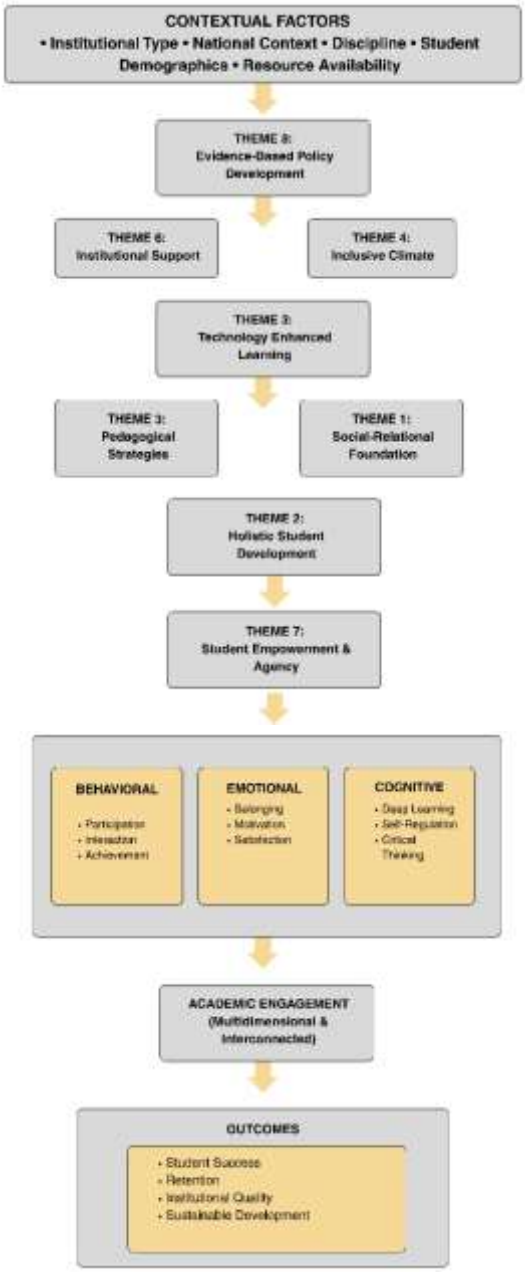

Figure 3. Contextual Factors

This framework illustrates the interconnected factors influencing academic engagement derived from the systematic review. Seven key themes—social-relational foundation, holistic student development, pedagogical strategies, technology-enhanced learning, inclusive climate, institutional support, and evidence-based policy development—operate within broader contextual factors such as institutional type, national context, discipline, student demographics, and resource availability. Academic engagement emerges as a multidimensional construct encompassing behavioral, emotional, and cognitive dimensions that interact dynamically to shape learning outcomes. These dimensions collectively foster student success, retention, institutional

quality, and sustainable educational development, emphasizing the need for coherent, evidence-based, and context-sensitive policy interventions in higher education.

DISCUSSION

This systematic literature review synthesized evidence from five high-quality studies to examine policy development as a strategic instrument for enhancing academic engagement in higher education. The synthesis revealed eight interconnected themes that collectively provide a comprehensive framework for policy-driven engagement enhancement: social-relational foundation, holistic student development, evidence-based policy development, technology-enhanced learning environments, inclusive academic climate, pedagogical strategies, institutional support structures, and student empowerment. The findings demonstrate that academic engagement is a multidimensional construct encompassing behavioral, affective, and cognitive dimensions, and that effective policy development must address these dimensions simultaneously through evidence-based, contextually-sensitive approaches that prioritize social relations, student wellbeing, and institutional support structures (Bond et al., 2020; Fredricks et al., 2004).

The centrality of social relations and community building identified in this review aligns strongly with previous research on student engagement. Seminal work on student integration theory emphasized the critical role of academic and social integration in student persistence, a finding consistently supported by subsequent research (Tinto, 1993; Kuh et al., 2008; Pascarella & Terenzini, 2005). More recently, a comprehensive study across multiple UK institutions found that fostering a sense of belonging through both curricular and co-curricular activities was fundamental to student success, particularly for non-traditional students (Thomas, 2012). Our synthesis extends this work by demonstrating how policy briefs can systematically translate these insights into actionable institutional strategies that strengthen social relations across multiple levels—from peer interactions to staff-student relationships and broader institutional communities.

The finding that soft skills and positive emotions serve as crucial mediators of academic engagement resonates with the growing body of research on non-cognitive factors in higher education success. A meta-analysis of 344 samples found that behavioral engagement indicators, while important, represented only part of the engagement picture, with motivational and emotional factors playing equally significant roles (Credé & Niehorster, 2012). Similarly, a systematic review of 241 studies identified self-efficacy, grade goal, and effort regulation as stronger predictors of GPA than traditional demographic variables (Richardson et al., 2012). Our synthesis contributes to this literature by showing how institutional policies can deliberately cultivate these non-cognitive competencies through structured interventions such as

soft skills development programs, emotional wellness initiatives, and supportive learning environments.

The emphasis on technology-enhanced learning environments reflects broader trends in higher education research. A comprehensive meta-analysis examining decades of online learning research found that blended learning approaches combining face-to-face and online elements produced better learning outcomes than either approach alone (Means et al., 2013). However, our synthesis adds nuance by identifying that technology's impact on engagement depends critically on how it supports structure, active learning, communication, and interaction—a finding consistent with the critique that technology per se does not improve learning, but rather the pedagogical approaches it enables (Kirkwood & Price, 2014). This underscores the importance of policy frameworks that emphasize pedagogically-informed technology integration rather than technology adoption for its own sake.

This synthesis makes several important theoretical contributions to understanding academic engagement in higher education. First, by integrating critical realist perspectives with empirical evidence on engagement mechanisms, the review advances a more sophisticated understanding of how structural factors (policies, institutional arrangements) interact with agential factors (student reflexivity, soft skills) to produce engagement outcomes (Kahn, 2017; Bond et al., 2020; Wang et al., 2025). This moves beyond deterministic models that view engagement as simply a function of student characteristics or institutional inputs, instead recognizing the complex interplay of context, agency, and social relations. This theoretical lens aligns with recent calls for more nuanced, processual understandings of engagement that acknowledge its dynamic and contextual nature (Ashwin & McVitty, 2015; Tight, 2020).

Second, the synthesis demonstrates the utility of applying the three-dimensional framework—behavioral, affective, cognitive engagement—to policy analysis in higher education (Fredricks et al., 2004). While this framework has been widely applied in K-12 research, its systematic application to higher education policy remains relatively underdeveloped (Reschly & Christenson, 2012). Our review shows how this framework can guide policy development by ensuring that interventions address multiple dimensions of engagement simultaneously, rather than focusing narrowly on easily observable behavioral indicators. This multidimensional approach is particularly important given evidence that the three dimensions are interrelated and mutually reinforcing, suggesting that policies targeting one dimension may have spillover effects on others (Wolters & Taylor, 2012).

For institutional leaders and policymakers, this review provides an evidence-based roadmap for developing policies that systematically enhance academic engagement. The identification of eight core themes offers a structured framework for conducting institutional audits to identify strengths and gaps in current engagement

support systems. Universities can use this framework to develop comprehensive policy briefs that address multiple levels simultaneously—from macro-level strategic planning and resource allocation to meso-level departmental support structures and micro-level pedagogical practices. Importantly, the review emphasizes that effective engagement policies must be grounded in local contexts while drawing on broader evidence bases, consistent with principles of realist evaluation that emphasize context-mechanism-outcome configurations (Pawson, 2013).

For academic staff and educational developers, the synthesis highlights the critical importance of creating inclusive learning environments characterized by strong social relations, active pedagogies, and meaningful student-staff interactions. The finding that hierarchical structures can impede engagement suggests the need for professional development that helps faculty develop more facilitative, student-centered teaching approaches (Linton et al., 2020). Similarly, the evidence on technology's engagement potential underscores the importance of supporting faculty in developing technological pedagogical content knowledge rather than simply providing access to educational technologies (Bond et al., 2020; Godsk & Møller, 2025; Mishra & Koehler, 2006). Institutions might consider establishing teaching and learning centers that provide ongoing support for evidence-based pedagogical innovation, as recommended in principles of good practice in the scholarship of teaching and learning (Felten et al., 2013).

Several limitations should be acknowledged when interpreting these findings. First, the review's focus on publications from 2015 to 2025 and restriction to specific databases (Scopus, DOAJ, Google Scholar) may have excluded relevant earlier work or research published in other outlets. While this approach ensured contemporary relevance and included the most recent research on post-pandemic higher education, it may have missed foundational studies that could provide additional historical context. Second, the small number of included studies (n=5), while reflecting the specificity of our research question and rigorous inclusion criteria, limits the generalizability of findings across different institutional types, national contexts, and disciplinary areas. The included studies were predominantly from Western, English-speaking countries (UK, USA, Australia, China), potentially limiting applicability to other cultural and educational contexts. Third, the heterogeneity of research designs across included studies—ranging from large-scale systematic reviews to small qualitative studies—while providing complementary insights, makes direct comparison and synthesis challenging. Finally, our reliance on published research may reflect publication bias favoring studies with positive findings, potentially overlooking interventions that were unsuccessful in enhancing engagement.

Several promising directions for future research emerge from this synthesis. First, there is a need for more longitudinal studies examining how policy interventions affect

academic engagement over time, including an investigation of potential delayed effects and the sustainability of engagement gains. Most existing research, including studies in this review, relies on cross-sectional or short-term designs that cannot capture the developmental trajectories of engagement or identify critical periods for intervention. Second, comparative research examining engagement policies across diverse institutional contexts—including different countries, institutional types (e.g., research-intensive versus teaching-focused universities), and disciplines—would help identify which policy elements are universally effective versus context-dependent. Such research could employ realist evaluation methodologies to systematically map context-mechanism-outcome configurations (Pawson, 2013). Third, more research is needed on the engagement experiences of underrepresented groups, including international students, students with disabilities, LGBTQ+ students, and first-generation students, to ensure that policy development truly promotes inclusive excellence. Fourth, given the rapid evolution of educational technologies, particularly generative AI, ongoing research is needed on how emerging technologies can be leveraged to support engagement while mitigating potential risks such as reduced authentic interaction or increased academic integrity concerns. Finally, there is a need for implementation science research examining the processes by which evidence-based engagement policies are translated into actual practice, including investigation of barriers and facilitators to policy adoption, adaptation, and sustainability within complex higher education organizations.

4. CONCLUSION

This study answers three research questions through a systematic synthesis of five high-quality articles. First, policy development to improve academic engagement focuses on: (1) building social-relational foundations, (2) adopting holistic student development, (3) advancing technology-based learning, (4) promoting inclusive academic climates, (5) enhancing pedagogy and curricula, (6) strengthening institutional support, (7) empowering students, and (8) using evidence-based policy. Second, policy briefs bridge research and practice by offering operational recommendations that: (1) build inclusivity, (2) boost institutional resilience, and (3) foster sustainable learning. Third, transformational leadership and evidence-based approaches are crucial; they (1) strengthen social relations, (2) develop soft skills and positive emotions, and (3) create environments supporting behavioral, affective, and cognitive engagement.

This study makes a theoretical contribution by integrating critical realism and the three-dimensional framework of engagement to guide higher education policy development. Practically, it delivers a comprehensive framework that institutions can use to audit and systematically enhance engagement policies. Key findings show that

alignment with the Merdeka Belajar–Kampus Merdeka (MBKM) policy supports active participation, collaboration, and student autonomy. Research-based policy briefs thus serve as catalysts for inclusive, resilient, and sustainable higher education. Specifically, greater academic engagement improves individual learning outcomes and strengthens the adaptability and equity of higher education systems for 21st-century challenges.

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Integration of AI and Coding in Indonesia's New Curriculum: A Literature Review

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ABSTRACT

The integration of Artificial Intelligence (AI) and programming (coding) into Indonesia's new curriculum reflects the nation's effort to prepare students for the realities of the 21st century, including digital literacy, computational thinking, and problem-solving skills. Although the policy direction signals meaningful progress, its implementation in schools is still uncertain, especially regarding teacher readiness and the availability of supporting resources.This study explores how AI, Computational Thinking (CT), and coding are positioned within Indonesia's curriculum policy and examines the extent to which these competencies can be translated into real classroom practice.Using a narrative literature review, this study analyzes journal articles, policy reports, and key curriculum documents to map both policy intentions and on-the-ground challenges.The review shows that CT has begun to appear in schools through simple activities, including unplugged methods and educational games. In contrast, coding is still introduced only at a basic level, and AI has not yet emerged as a structured component of classroom instruction. Persistent challenges include limited technological infrastructure, varied levels of teacher competence, and the absence of clear operational guidelines. These findings suggest that, while the integration of AI and coding aligns with future skill demands, implementation must be gradual and realistic. CT offers the most feasible starting point before schools progress toward more advanced AI and coding learning. Strengthened teacher training, more equitable access to digital resources, and the development of step-by-step instructional guidelines are essential to support the effective integration of digital competencies in schools.

Keywords: *Artificial Intelligence (AI), Coding, Computational Thinking, Curriculum Integration, Indonesia's New Curriculum*

1. INTRODUCTION

The rapid advancement of digital technologies has reshaped the competencies required in the twenty-first century, prompting education systems worldwide to redesign their curricula to include digital literacy, Computational Thinking (CT), and introductory programming. A growing body of international research shows that introducing CT at early grade levels can strengthen students' reasoning, problem-solving, and readiness for more advanced skills such as coding and Artificial Intelligence (AI) literacy (Kaarakainen et al., 2021; Seow, 2020; Kim & Kim, 2019). Computational Thinking has long been recognized as a core problem-solving framework for young learners (Brennan & Resnick, 2012). Wing (2006) positioned CT as a universal cognitive skill that extends beyond computer science, which later shaped global curriculum reforms. CT also provides a conceptual foundation for the development of coding and algorithmic reasoning (Grover & Pea, 2013).

In response to these global developments, Indonesia has introduced AI and coding into its new national curriculum through *Peraturan Menteri Pendidikan Dasar dan Menengah Nomor 13 Tahun 2025*, supported by the *Naskah Akademik Mata Pelajaran Coding dan Kecerdasan Buatan*. These policy documents signal the government's commitment to enhancing students' digital competencies and encourage flexible implementation, including unplugged learning approaches, to accommodate variations in school resources and teacher readiness. Recent data indicate that disparities in digital infrastructure remain a major challenge in Indonesia. According to the Ministry of Education, only around 62% of schools have stable internet access, with significant gaps between urban and rural areas. This condition highlights the structural barriers that may hinder the effective implementation of AI and coding education across diverse educational contexts. Several scholars also note that programming activities can significantly strengthen students' CT skills when designed appropriately (Lye & Koh, 2014). Despite this progressive policy direction, the extent of actual readiness among schools and teachers remains unclear. Internationally, countries such as Singapore have implemented structured progression models for AI and coding integration (Ministry of Education, 2020). Existing studies continue to highlight disparities in digital infrastructure, uneven teacher competencies, and significant differences in institutional capacity across regions (Suryani, 2022; Putra & Dewi, 2023).

However, current literature has not yet provided a comprehensive analysis that explicitly connects Indonesia's new curriculum directives with real conditions in classroom practice. Most existing studies focus on isolated aspect such as teacher readiness, digital infrastructure gaps, or small-scale CT and coding initiatives without examining how these elements align with the expectations set in national policy. Unlike countries that implement structured, phased models beginning with CT and progressing to AI and coding, Indonesia does not yet have an evidence-based roadmap adapted to its contextual challenges. This absence of an integrated progression framework represents a clear research gap.

Therefore, this study conducts a narrative literature review of curriculum policy documents, national research, and international models of digital competency development. The purpose is to analyze how AI, CT, and coding are positioned within Indonesia's curriculum; synthesize national and global evidence on their implementation; and propose a realistic, staged approach that aligns policy aspirations with school-level realities. Through this analysis, CT is positioned as a foundational competency, with AI and coding envisioned as sequential skills that must be introduced gradually and contextually.

To address this gap, this study seeks to align national curriculum expectations with practical realities in schools, focusing on how digital competencies can be

implemented progressively based on readiness and context rather than through a uniform nationwide mandate.

The objectives of this study are to:

1. Analyze how Computational Thinking (CT), coding, and Artificial Intelligence (AI) are positioned within Indonesia's latest curriculum reform documents.
2. Identify contextual factors and implementation challenges faced by schools, particularly related to teacher readiness and digital infrastructure.
3. Propose a staged integration approach suitable for Indonesian basic education settings.

Based on these objectives, this study is guided by the following research questions:

1. How are CT, coding, and AI conceptualized within Indonesia's new curriculum policy documents?
2. What existing conditions in schools (teacher competence, infrastructure, resources) support or hinder their implementation?
3. What phased implementation model could realistically guide the integration of CT, coding, and AI in Indonesian classrooms?

2. METHODOLOGY

This study employed a qualitative narrative literature review to explore how Computational Thinking (CT), coding, and Artificial Intelligence (AI) are positioned in Indonesia's new curriculum and how these policy directions relate to the realities of school implementation. A narrative review was considered appropriate because it allows for a flexible yet systematic synthesis of diverse written sources, ranging from curriculum regulations to academic publications, without the rigid procedural requirements found in systematic reviews.

2.1 Research Design

The research followed an interpretive narrative literature review design. This approach made it possible to examine how CT, coding, and AI are conceptualized across different documents and to compare these ideas with international practices. Each document was reviewed for its purpose, key arguments, methodological approach (when available), and relevance to curriculum development and implementation.

2.2. Participants of the Study

Because this research is a document-based literature review, there were no human participants involved in the study. The term "participants" in this context refers to the documents included in the review. Sources included peer-reviewed journal

articles, national curriculum regulations, government policy papers, research reports, and academic publications related to CT, coding, and AI.

Only documents that (1) clearly discussed digital competencies in primary or secondary education, and (2) came from credible academic or institutional sources were included. Materials without clear authorship, credibility, or relevance were excluded.

2.3. Instruments

To organize the narrative review process, three simple instruments were used:

1. Screening Checklist
   Used to assess whether a document matched the topic focus (CT, coding, AI) and education level.
2. Quality Assessment Notes
   Used to review the clarity, reliability, and usefulness of each document. Instead of strict scoring, this instrument provided reflective notes to judge whether a document was appropriate for deeper analysis.
3. Data Extraction Table
   Used to record important information including author, year of publication, context, methodology, main findings, policy relevance, and implications for Indonesia.

These instruments helped keep the review systematic while still maintaining the flexibility characteristic of narrative reviews.

2.4. Data Analysis Techniques

The data were analyzed using thematic analysis, which aligns naturally with a narrative literature review. The analysis involved four steps:

1. Reading and Familiarization
   All selected documents were read closely to understand their main ideas and arguments.
2. Initial Coding
   Key statements related to CT, coding, AI, curriculum directions, and implementation challenges were identified and coded.
3. Theme Development
   Codes were grouped into broader themes such as policy orientation, school practices, barriers, and international models.
4. Synthesis
   The themes were combined to produce a comprehensive interpretation of Indonesia's current position and to outline realistic pathways for integrating CT, coding, and AI in stages.

This process allowed the researcher to connect insights across documents and identify gaps that remain in policy and practice. The reviewed literature consisted of 15

sources published between 2019 and 2025, drawn from academic journals, national policy documents, and institutional reports related to CT, coding, digital literacy, and AI in basic and secondary education. The selection prioritised works that discussed both conceptual frameworks and practical classroom implementation. Sources were collected through Google Scholar, policy repositories, and institutional archives. Materials lacking clear authorship or direct relevance were excluded. Thematic analysis enabled the synthesis of recurring patterns across policy direction, school readiness, and international practices, allowing the findings to be interpreted contextually rather than generalised statistically.

3. RESULTS AND DISCUSSION

The narrative review produced several key findings regarding the positioning and implementation of Computational Thinking (CT), coding, and Artificial Intelligence (AI) in Indonesia's newest curriculum reform. This section discusses these findings by connecting them with relevant theories, national conditions, and international experiences.

3.1 Policy Orientation on CT, AI, and coding

The review indicates that Indonesia's most recent curriculum reform formally highlights Computational Thinking (CT), coding, and Artificial Intelligence (AI) as key digital competencies for twenty-first century learning. Policy documents such as *Permendikdasmen No. 13 of 2025* and the Academic *Paper for Coding and Artificial Intelligence* present CT as the conceptual foundation on which AI and coding literacy should be built. These documents also encourage flexible implementation approaches, including unplugged activities, to accommodate the diverse conditions of Indonesian schools.

Although the policy direction is clearly articulated, the curriculum still provides high-level conceptual guidance without specifying detailed competency progressions, instructional models, or assessment criteria. This lack of operational clarity results in highly varied interpretations of policy expectations, as schools and teachers attempt to implement the competencies based on their own understanding and available resources.

Despite the strong policy vision, the curriculum still offers broad conceptual directions without providing detailed operational guidance.Recent studies also highlight the need for practical, teacher-friendly models to support implementation at the classroom level (Khosibah et al., 2025). There are no explicit learning progressions, structured instructional models, or standardized assessment frameworks for CT, coding, or AI integration. As a result, schools interpret these expectations in different ways, leading to varied and inconsistent implementations across regions. Further

details are elaborated in the Academic Paper on Coding and Artificial Intelligence, which provides conceptual guidelines for competency development.

3.2 Classroom Implementation: CT, AI, and Coding Practices

Implementation across Indonesian schools is uneven. CT is the most commonly practiced competency, introduced through low-tech, hands-on activities such as sequencing tasks, pattern-based games, puzzles, and basic problem-solving exercises. These activities are feasible because they do not require digital devices or advanced infrastructure. The variation in teachers' competencies is largely influenced by unequal access to professional development opportunities, limited exposure to computational thinking and AI-related pedagogy, and the absence of standardized national guidelines. Many teachers rely on self-directed learning or short-term training programs, which often lack continuity and practical classroom application. As a result, the implementation of AI and coding remains fragmented and highly dependent on individual teacher initiative rather than systemic support.

In contrast, coding is typically introduced through extracurricular programs, limited pilot initiatives, or collaborations with external organizations. AI education is almost entirely absent from formal classroom instruction. Schools face several limitations, including inadequate digital devices, unstable internet access, and teachers' limited confidence in teaching programming or AI-related concepts.

This pattern aligns with international research indicating that infrastructure and teacher preparedness are the strongest predictors of successful digital literacy implementation

3.3 Barriers and Challenges

The literature consistently identifies several challenges that hinder the effective implementation of CT, coding, and AI in Indonesian schools. These challenges appear across different regions and school types, indicating systemic issues rather than isolated cases. The main barriers that emerge from the reviewed sources include the following:

1. Infrastructural disparities

Many schools lack sufficient devices, laboratories, and stable internet access, making AI and coding difficult to implement.

2. Variations in teacher competence

Teachers show different levels of digital literacy and pedagogical readiness. Low confidence in teaching coding or AI remains a common issue, as reflected in national studies.

3. Lack of operational guidance

Although the curriculum highlights CT, coding, and AI as key competencies, it does not provide detailed teaching models or step-by-step implementation guidance. This gap leaves teachers without practical resources to translate policy into classroom practice.

These challenges collectively illustrate the gap between policy expectations and school-level readiness. Limited infrastructure restricts opportunities for meaningful AI and coding activities, uneven teacher competence reduces instructional quality, and the absence of practical curriculum guidance makes implementation inconsistent across settings. Several Indonesian studies point out that teacher capacity-building remains one of the most urgent needs for digital learning implementation (Chaniago et al., 2025). Classroom observations show that CT can be introduced effectively through unplugged activities, but scaling these practices requires better support (Isharyadi, 2023).

3.4 International Models and Lessons Learned

International implementation models demonstrate the effectiveness of phased, scaffolded learning progressions. Countries with successful integration offer clear progression pathways.

- Singapore has introduced CT and coding since 2014 through *Code for Fun* and expanded to AI literacy under its *AI for Students* roadmap (Woo, 2025).
- Finland incorporated CT and programming into its 2016 national curriculum, embedding them across subjects through robotics and project-based learning (Casal-Otero et al., 2023).
- South Korea mandated software education in 2018, starting with CT in primary school and progressing to programming and AI modules in secondary school (Xu & Ouyang, 2022).
- Australia's Digital Technologies Curriculum (2015) integrates CT and coding systematically from Year 1 and introduces data-driven AI concepts in upper grades (Crompton et al., 2023).

Across these systems, shared characteristics include national progression frameworks, extensive teacher training, and abundant curriculum resources (Garzón et al., 2025). The success of these countries reinforces global consensus that digital competency education requires structured scaffolding.

3.5 Implications for Indonesia

Based on the findings, a gradual and context-sensitive implementation pathway is essential for Indonesia. Schools very widely in their infrastructure, teacher readiness, and institutional capacity, which means that integrating CT, coding, and AI must follow

a phased progression rather than a uniform approach. Listiowati (2025) emphasizes that digital competency integration must consider school context to ensure long-term sustainability. A realistic and developmentally appropriate roadmap would consist of the following stages:

1. Strengthen CT as the foundation in early grades.
2. Introduce unplugged and block-based coding progressively.
3. Expand to text-based programming once foundational skills are stable.
4. Introduce basic AI literacy only when coding foundations have been established.

This sequenced approach ensures that students develop the necessary conceptual and technical foundations before engaging with more complex digital competencies. To support this progression, sustained teacher professional development, improved access to digital infrastructure, and clearer instructional guidance are required. These elements will be critical in aligning policy aspirations with the practical realities of school environments across Indonesia. Teacher confidence plays a crucial role in determining whether digital competencies can be integrated effectively at the classroom level (Putra & Dewi, 2023).

4. CONCLUSION

This study set out to analyze how Computational Thinking (CT), coding, and Artificial Intelligence (AI) are positioned within Indonesia's latest curriculum reform and to consider how these policy intentions correspond with actual conditions in schools. Through a narrative literature review, the study found a clear distinction between the curriculum's ambitious vision and its current level of implementation. CT has begun to find its place in classroom practice because it can be delivered through accessible, low-tech activities. In contrast, coding remains limited in scope, often appearing only through isolated initiatives, and AI has not yet emerged as a structured element of teaching and learning.

The findings underscore a persistent gap between policy aspiration and educational readiness. Many schools continue to grapple with limited technological infrastructure, and teachers vary considerably in their digital competence and pedagogical confidence. Moreover, the curriculum provides high-level direction but lacks the detailed instructional guidance needed to support consistent implementation. When viewed alongside international models that employ phased, well-supported progression frameworks, it becomes evident that Indonesia has yet to develop an operational roadmap that is both contextually realistic and scalable.

To move forward, a gradual and carefully sequenced approach is essential. Strengthening CT as a foundational competency offers the most feasible starting point, after which schools can progressively introduce unplugged and block-based coding, followed by text-based programming and, eventually, age-appropriate AI literacy.

Achieving this vision will require sustained investment in teacher development, equitable access to digital tools, and the creation of clear, practical implementation guidelines. By addressing these areas, Indonesia can bridge the gap between curriculum policy and classroom practice and advance toward a more robust and future-oriented digital education landscape.

In addition to these implications, future research should move beyond policy analysis and begin examining empirical classroom implementation across diverse school contexts. Studies involving lesson design, teacher training models, and classroom-based interventions will be essential to validate phased integration approaches. Pilot projects that compare unplugged, block-based, and text-based programming pathways can also provide practical insights for adapting curriculum expectations to teacher readiness and school infrastructure.

Therefore, this study recommends the development of a national operational guideline to support teachers in implementing AI and coding education in a structured, scalable, and context-sensitive manner.These efforts will help ensure that curriculum reform is supported by evidence from real learning environments rather than policy assumptions alone.

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Designing a Microcredential-Based Ethnofood Training Curriculum: a Literature Study

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ABSTRACT

The growing adoption of microcredential programs in higher education has created new opportunities for developing flexible, competency-based training that responds to evolving cultural and professional needs. This study aims to develop a microcredential-based Ethnofood training curriculum as a conceptual framework for integrating local food culture and traditional wisdom into higher education. It employs a qualitative descriptive approach through a comprehensive literature review and documentation analysis. Various theories, curriculum models, and previous research findings are systematically examined to identify essential elements, learning principles, and suitable design strategies for Ethnofood-based training. The proposed curriculum design aligns with the Indonesian National Qualifications Framework (KKNI), emphasizing a competency-based modular structure that reflects flexibility, contextual relevance, and learner-centeredness. Each learning module is crafted to showcase a specific Ethnofood theme by integrating cultural, practical, and scientific dimensions of local food systems. Consideration of philosophical, sociological, psychological, historical, and legal foundations ensures the curriculum's coherence and applicability within higher education settings. The study results in a conceptual model for an Ethnofood training curriculum that is both structured and adaptable, fostering the preservation of local wisdom, innovation, and sustainability in learning practices. Conceptually, this research advances the development of the Ethnofood training model and provides practical guidance for educational institutions seeking to create microcredential programs that strengthen cultural identity and promote reflective learning among students.

Keywords: *ethnofood, microcredential, training curriculum.*

1. INTRODUCTION

Ethnofood or what is often known as ethnic food is ethnic food, food that has a story and history behind it, is consumed today because more and more people are eating to appreciate culture, not just for survival reasons (Ting et al., 2017). Food is an identity that is inherent in human daily life. What is consumed from one region to another, from one ethnic group to another, and from one nation to another can generally differ in terms of ingredients, form and taste. This means that food is connected to collective tastes formed by the living environment and human culture. Food is not just a matter of identity, but includes various complex things and problems and is not just processed, served, enjoyed and then finished at the dinner table (Rahman, 2019).

Discussions about food cannot be separated from culture. As a cultural tourism product, the role of culinary tourism is becoming increasingly important (Wijaya, 2019). Local food can be used as a tool to differentiate one destination from other destinations because a country's cuisine shows elements of culture and national identity. Food is also used to give meaning to oneself, making food practices not only practical decisions influenced by access, environment, and nutritional needs, but also decisions that are fundamentally social, cultural, and psychological (Reddy & van Dam, 2020). Additionally, food is at the heart of the Sustainable Development Goals (SDGs), the UN's development agenda for the 21st century. The second goal of the 17 UN SDGs is "End hunger, achieve food security and improved nutrition, and promote sustainable agriculture." To achieve this goal by 2030, major changes to the global food and agricultural system are needed.

The problem facing the world today is that changes in the world food market are so rapid that it can be observed in the mid-2000s. For two decades, leading up to the millennium, global food demand continued to rise, along with world population growth, record harvests, new technologies, rising incomes, and diversifying diets. Food prices continued to decline until 2000. However, in 2004, prices for most grains began to rise. Rising production has not kept pace with stronger demand growth. Food stocks are running low. And then, in 2005, food supplies were hampered by disappointing harvests in major food-producing countries. In 2006, world cereal production fell by 2.1 percent. In 2007, rapid increases in oil prices increased the costs of fertilizer and other food production.

As international food prices reach unprecedented levels, many countries are looking for ways to protect themselves from potential food shortages and price shocks. Several food exporting countries impose export restrictions. Certain major importers started buying grain at any price to maintain domestic supplies. However, the global economic crisis in 2008 and 2009 also had a negative impact on food security in many countries. What happens if food security is poor? If food security decreases, people tend to eat whatever is in front of them, let alone think about culture, just being able to eat is lucky. And if that happens, then the food that was previously said to be the identity of a nation could become extinct. Therefore, investment in agriculture and rural development to increase food production and nutrition is a priority for The World Bank Group. The World Bank Group works with its partners to increase food security and build food systems that can feed everyone, everywhere, every day. Activities include encouraging climate-smart farming techniques and restoring degraded farmland, developing more resilient and nutritious crops, and improving storage and supply chains to reduce food loss.

Apart from the issue of food security that needs to be considered, globalization also causes uniformity in one's lifestyle. Globalization has increased the uniformity of

lifestyles of food consumption, clothing and entertainment (food, fashion, fun) among members of different communities (Effendy et al., 2021). A manifestation of globalization is the homogenization of the lifestyle of eating fast food which is endemic to almost all of the world's population. This phenomenon is better known as McDonaldization, which was initiated by George Ritzer in 1993 as a result of his research on the management of McDonald's fast food restaurants. The results of his study, published in the monumental book entitled The McDonaldization of Society: An Investigation Into The Changing Character of Contemporary Social Life, describe the management of fast food restaurants based on modern scientific management rationalization such as efficiency, calculation, calculation and supervision. Similar symptoms also occur when consuming Coca Cola canned drinks, which is called Coca Colonization. The direct impact is that people will be more interested in trying to consume food at fast food restaurants because they look western and the newest, rather than tasting traditional food that looks ancient and outdated. If this continues, traditional food will be lost and eventually become difficult to find (as has been happening recently). Some traditional foods and drinks are now starting to disappear from the surface. If there are no preservation efforts for traditional food, what could happen is that people will not recognize their typical food, and the impact of this food could be recognized by other nations, and the nation itself will be more interested in food from other nations as a result of globalization.

The role of education in responding to these problems is very necessary. Education for Sustainable Development (PPB) or Education for Sustainable Development (ESD) is an effort to empower everyone to be able to make decisions based on correct information to always maintain environmental integrity, economic viability and justice in social life for present and future generations, and respect all cultural diversity implemented at all levels and types of education (UNESCO, 2014). Through education, cultural diversity, including food, can be well organized and documented. Through education, learning can be designed that aims to overcome various problems related to food culture in Indonesia. For this reason, a curriculum is needed that can facilitate the introduction and preservation of this food culture.

The ethnofood curriculum was developed through a separate microcredential model, a stand-alone, independent learning program not directly linked to specific courses. This approach offers Ethnofood as a specific competency-based learning unit that can be flexibly taken by students across study programs. A microcredential is a form of mini-certification that confirms a student's attainment of specific skills, knowledge, or experience in a specific field, including the study of local food culture (Zou et al., 2023). This model allows students to gain official recognition for their ethnofood competency without having to wait for completion of a regular course. Microcredentials focus on validating competency-based learning outcomes through

measurable, transparent, and verifiable criteria, enabling students to develop practical skills and a contextual understanding of local food, which can strengthen graduate profiles and enhance job readiness in education, food, or community development (McGreal & Olcott, 2022). The development of the Ethnofood curriculum in a microcredential format is considered strategic, given its urgency in equipping students with cultural literacy and food security, as well as supporting the preservation of local knowledge through higher education.

2. METHODOLOGY

This section outlines the approach and procedures used to develop the design of an Ethnofood microcredential training curriculum through a literature review and document analysis. A qualitative approach (Suwandayani, 2018) was employed because the study focuses on exploring concepts and interpreting theoretical foundations. The methodology is organized into four main components as follows.

2.1. Research Design

This study adopts a qualitative descriptive design to describe concepts and principles relevant to curriculum development. This design allows for a systematic understanding of the phenomenon based on written sources without the need for field data collection.

2.2. Participants of the Study

The sources of data consist of scholarly literature, including books, journal articles, educational policy documents, regulations related to the Indonesian National Qualifications Framework (KKNI), and references on microcredentials. All sources were selected based on relevance and credibility.

2.3. Instruments

The primary instrument in this study is the researcher, supported by a literature review guide and data recording sheets to identify, organize, and categorize information from various sources.

2.4. Data Analysis Techniques

Data were analyzed inductively through the stages of data collection, data reduction, data display in the form of categories and themes, and conclusion drawing based on the interpretation of findings from the literature.

3. RESULT AND DISCUSSION

Curriculum development is the right and obligation of each institution/institution. The curriculum should be able to deliver participants to master certain knowledge and

skills, as well as form noble character, so that they can contribute to maintaining national values, diversity, encouraging a spirit of concern for fellow nations and humanity to improve social welfare with justice and the glory of the nation. Indonesia. Curriculum preparation should be based on a strong foundation, both philosophically, sociologically (socio-culturally), psychologically, historically and juridically. The basic basis for designing and developing this curriculum is as follows.

Philosophical foundation, providing philosophical guidance at the design, implementation and quality improvement stages of education (Ornstein & Hunkins, 2018), how knowledge is assessed and studied so that participants understand the nature of life and have abilities that are able to improve the quality of their life both individually and in society (Zais, 1976).

The sociological basis provides a foundation for the development of the curriculum as an educational tool consisting of objectives, materials, learning activities and a positive learning environment for the acquisition of learner experiences that are relevant to the learner's personal and social development (Ornstein & Hunkins, 2018). The curriculum must be able to pass on culture from one generation to the next amidst the influence of globalization which continues to erode the existence of local culture. There is a need to introduce aspects of local culture to protect ourselves from the influence of globalization. Indonesian society, sociologically, has a unique "character" and may be different from other societies in the world. By making the characteristics of Indonesian society the basis for curriculum development, the learners who are taught will not be alienated from their social environment. Thus, education does not actually alienate individuals from their environment (Purba, 2023).

The psychological foundation provides the foundation for the development of this curriculum, so that the curriculum is able to continuously encourage participants' curiosity and can motivate lifelong learning; curriculum that can facilitate learning participants so that they are able to realize their roles and functions in their environment; a curriculum that can cause participants to think critically, and think at a higher level (higher order thinking); a curriculum that is able to optimize the development of participants' potential to become the desired human being (Zais, 1976); a curriculum that is able to facilitate participants learning to become complete human beings, namely people who are free, responsible, self-confident, moral or have noble character, able to collaborate, be tolerant, and become well-educated human beings who are determined to contribute to achieving the ideals in the preamble to the 1945 Constitution.

Historical basis and development of society, curriculum that is able to facilitate learning according to the times; a curriculum that is able to pass on the cultural values and golden history of past nations, and transform it in the era in which one is studying; a curriculum that is able to prepare participants to live better in the 21st century, have

an active role in the era of society 5.0, and be able to read signs of development. Society continues to develop. Aspirations, hopes and demands also develop. These developments are accommodated in this curriculum, the rapid development of society must be one of the foundations.

The basis of community needs, educational institutions are actually formed by the community, supported by the community and therefore, they must provide benefits to the community. The curriculum that will be developed later will be in accordance with community needs. In other words, the curriculum being developed will have value for society.

This curriculum development uses principles that have developed in everyday life. The principle of relevance means that it contains the meaning of appropriate, commensurate, harmonious and in line. Therefore, this curriculum must be relevant to the demands of people's lives. In this case, Ethnofood is very relevant for lectures at universities. If referring to the principle of relevance, the curriculum must at least pay attention to internal and external aspects. Internally, the curriculum has relevance between curriculum components (objectives, materials, strategies, organization and evaluation). Meanwhile, externally, this component has relevance to the demands of lectures and technology (epistemological relevance), the demands and potential of students (psychological relevance), as well as the demands and needs of community development (sociological relevance) (Prasetyo & Hamami, 2020).

The principle of effectiveness means whether the education provided has achieved the stated objectives. In this principle, two aspects are considered, namely: the teaching effectiveness of lecturers and the effectiveness of student learning. In the teaching aspect of lecturers, if they are still less effective in teaching teaching materials or programs, then that becomes material in developing the curriculum in the future. Meanwhile, the aspect of student learning effectiveness is related to the learning methodology so that what has been planned can be achieved with methods that are relevant to the learning material or materials.

The principle of flexibility here means "not rigid", meaning that there is a space for movement in the curriculum that provides opportunities, possibilities and freedom of action. A good curriculum is a curriculum that contains solid things, but in its implementation it is possible to make adjustments based on regional conditions. Time and abilities and student background. This curriculum prepares students for the present and the future. This is very in line with the cultural values contained in Ethnofood as a learning resource.

Ethnofood comes from the word ethnos which means nation and the word food which means food, so Ethnofood means food belonging to a particular ethnic group or social group. Ethnofood can also be defined as processed food from a particular nation that is characteristic of it. Ethnofood or traditional processed food is food consumed by

an ethnic group in a certain area, and is indigenous knowledge possessed by an ethnic group and is local wisdom. This processed food is obtained by utilizing natural biological resources in the environment where they live (Syamsuri et al., 2023).

Traditional food or traditional food is a form of culture that has regional, specific characteristics and types that reflect the natural potential of each region, which in its function influences the behavior of the supporting community (Ardana et al., 2023). Food is useful for maintaining relationships between people and as a regional characteristic of certain community groups. According to Foster and Anderson, food has an expression of meaning related to social bonds, group solidarity, food and mental tension, as well as the symbolism of food in language. This shows that food contains aspects of strengthening social bonds and social solidarity in the community that produces it.

This food processing is indigenous knowledge or local wisdom of an ethnic group in a particular region, and is expected to be able to reduce the financial crisis (Syamsuri et al., 2022). Diversification of traditional food processing based on local wisdom is a form of knowledge that is unique to an ethnic group, which has been obtained from generation to generation, by utilizing the biodiversity that exists in the ecosystem environment where it lives. Apart from increasing value or quality, diversification of traditional food processing can also increase the durability or shelf life of processed products.

Various research on food has been carried out in various fields, such as that carried out by Nogueira et al. (2022) by developing and implementing a food literacy curriculum for elementary schools in Sintra, Portugal. The curriculum is designed to increase students' knowledge and skills in choosing and consuming healthy foods. This is different from Syamsuri & Alang (2021) who carried out an inventory of Zingiberaceae plants which have economic value as ethnomedicine, ethnocosmetics and ethnofood in North Kolaka Regency, Southeast Sulawesi, Indonesia.

Then Zubaidah & Nurjanah (2021) discussed the development of a curriculum based on local wisdom in the "Indonesian Food" course for prospective professional chefs. Fyfe et al. (2022) in their article discusses a framework for responsible research with Australian native plant foods. The article highlights the importance of considering social, cultural and environmental aspects in conducting research on traditional foods and native plants. Research by Niu et al. (2021) discusses a full-time Professional Master's training mode in the field of Food Processing and Safety amidst the rapid development of the food industry. This article provides an overview of the curriculum designed and training methods implemented to prepare students to become skilled and trained professionals in the fields of food processing and safety. Meanwhile, Adebayo & Mudaly (2019) created a curriculum that was decolonized (distanced itself from the influence of colonialism) to overcome food insecurity among university students.

Voinea et al. (2019) conducted research on food behavior in Romania and how it can support healthy eating habits. Taylor & Anderson (2020) researched concepts in ethnobotany, namely the conservation of culinary culture and key cultural food groups. The article explains how food is an integral part of cultural identity and why biodiversity conservation is important in maintaining cultural diversity. Hassan et al. (2021) through their research provides interesting insights into the importance of the relationship between food and culture among the indigenous people of Kashmir. In contrast to Pandey et al. (2022) which discusses biodiversity in agricultural and food systems in the Jhum Landscape in West Garo Hills, northeastern India.

Jacob & Albuquerque (2020), in their research discuss the importance of promoting a sustainable diet by utilizing the biodiversity of food plants. The author explains that maintaining the biodiversity of food plants is very important in achieving food security and maintaining a healthy environment. Gartaula et al. (2020) researched traditional food knowledge and food literacy among youth in rural areas of Nepal. The author explains how traditional knowledge and food literacy can influence people's diet and health.

The various studies above show how important food literacy is for students and the development of curriculum and learning strategies that support the development of food literacy skills. This relates to the importance of a critical approach (critical food systems pedagogy) in developing a holistic understanding of the food system and fostering analytical and critical skills in students. Apart from that, the existence of Ethnofood can highlight the responsibility of higher education institutions in helping students develop food literacy and critical skills.

The research carried out to design the micro-learning based Ethnofood curriculum will use a design and development research approach. In this research, a framework is used that refers to the characteristics of product development research. This framework involves six important stages of the research procedure model using the D&D model, which include a) identifying the problem motivating the research; b) describe the objectives; c) design and develop the artifact; d) subject the artifact to testing; e) evaluate the results of testing; and f) communicate the results (Darmawan, 2021).

4. CONCLUSION

The preparation of this curriculum will be based on a strong foundation, both philosophically, sociologically (socio-culturally), psychologically, historically and juridically, with the principles of relevance, effectiveness and flexibility. The research carried out to design the microcredential based Ethnofood curriculum will use a design and development research approach. In this research, a framework is used that refers to the characteristics of product development research. This framework involves six important stages of the research procedure model with the D&D model, namely

identifying the problem motivating the research, describing the objectives, design and developing the artifact, subject the artifact to testing, evaluate the results of testing, and communicate the results.

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The Role of Digital Libraries in Supporting Curriculum Transformation for Elementary Education

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ABSTRACT

The aim of this study was to explore the role of digital libraries in supporting curriculum transformation in elementary education. It sought to describe how teachers utilized digital libraries in their instructional practices, how these platforms contributed to curriculum innovation, and what challenges were encountered during their implementation. A qualitative descriptive design was employed to capture teachers' lived experiences in integrating digital libraries into teaching and learning. Data were collected through semi-structured interviews with five elementary school teachers and analyzed thematically. The findings revealed three major themes. First, digital libraries expanded access to diverse and flexible learning resources, enabling differentiated and engaging instruction. Second, they facilitated curriculum adaptation and innovation, allowing teachers to align learning materials with current and contextual needs. Third, effective implementation required adequate digital literacy, student readiness, and institutional support. Despite their benefits, limited infrastructure and insufficient competence remained barriers. This study concluded that digital libraries functioned as catalysts for pedagogical renewal, fostering independent learning, collaboration, and the development of 21st-century competencies among young learners.

Keywords: *curriculum transformation, digital libraries, elementary education*.

1. INTRODUCTION

The rapid advancement of information and communication technology (ICT) has significantly influenced education, transforming the ways in which information is accessed, stored, and utilized (Kumar, 2020; Bennett & McWhorter, 2021). Libraries, once limited to physical collections of printed materials, have evolved into digital environments that support flexible, inclusive, and sustainable learning. According to the International Federation of Library Associations and Institutions (IFLA), a digital library is an organized online collection of digital objects managed according to international standards to ensure accessibility and long-term preservation (Iqbal & Soleha, 2022). The integration of digital libraries into educational settings enhances access to diverse learning materials, encourages independent learning, and contributes to improving the overall quality of education (Amaliah et al., 2022; Arum & Marfianti, 2021).

The implementation of digital libraries in education is underpinned by constructivist and connectivist learning theories, both emphasizing active engagement and knowledge construction through exploration and collaboration (Suwana, 2021; Zibak et al., 2021). Within these frameworks, learners interact dynamically with digital

resources, shaping their own understanding through inquiry and reflection. In addition, digital literacy theory highlights the importance of equipping students with the ability to locate, evaluate, and utilize digital information effectively (Hari et al., 2023). For elementary school students, these abilities form the foundation of independent learning, critical thinking, and creativity—competencies central to 21st-century education.

Curriculum transformation refers to the dynamic process of rethinking educational content, pedagogy, and assessment to better equip students for contemporary challenges (Fullan & Langworthy, 2014). It emphasizes a shift from knowledge transmission toward deeper learning, where learners construct meaning through exploration and problem solving. Within this process, digital libraries play a strategic role as gateways to diverse and up-to-date learning resources that promote critical inquiry, creativity, and cross-disciplinary understanding. By providing immediate access to global knowledge, they help bridge the gap between traditional curriculum structures and the demands of twenty-first-century education.

Digital libraries also foster curriculum differentiation and personalization, enabling teachers to select or design materials suited to varying student needs and learning styles (Okunlaya et al., 2022; Lee et al., 2022) . The inclusion of multimedia content such as e-books, interactive simulations, and educational videos creates engaging and multimodal learning experiences that support conceptual understanding. These resources encourage students to pursue independent exploration, collaborate in digital environments, and apply learning to authentic contexts (Dhawan, 2020; Gupta & Quamara, 2020). In this way, digital libraries help realize curriculum goals related to critical thinking, communication, and digital literacy.

From a broader perspective, digital libraries function as innovation ecosystems that sustain ongoing curriculum renewal. They connect educators, researchers, and policymakers in developing, curating, and sharing high-quality educational resources aligned with evolving curricular priorities. In the context of elementary education, this collaboration strengthens curriculum coherence and responsiveness to local and global issues. Particularly in Indonesia, the integration of digital libraries aligns with the Kurikulum Merdeka framework, which promotes flexible, student-centered, and technology-enriched learning.

Despite rapid digital advancement, the utilization of digital libraries in elementary education remains limited. Many schools still depend on conventional materials, and teachers often lack training in managing and integrating digital resources into classroom activities. The COVID-19 pandemic further exposed these weaknesses, revealing gaps in digital readiness, access to online references, and the effective use of digital platforms (Gul & Bano, 2019; Makarov et al., 2022). Moreover, Indonesia's low literacy ranking in the 2019 PISA assessment (62nd out of 70 countries) underscores

persistent challenges related to reading culture and access to quality educational resources (OECD, 2019).

Addressing these challenges requires the systematic integration of digital libraries into the elementary curriculum. Schools should position digital libraries as core learning resources that support inquiry-based and project-based learning. Teachers need continuous professional development to strengthen their competence in digital literacy and instructional design, while institutions must ensure adequate infrastructure, relevant content, and cross-sector collaboration. Through these initiatives, digital libraries can serve as key instruments of curriculum transformation and literacy enhancement.

This study aims to explore and describe the role of digital libraries in supporting curriculum transformation in elementary education. It focuses on understanding how teachers utilize digital libraries in their instructional practices, how these platforms contribute to curriculum innovation, and what challenges educators encounter in the process. Furthermore, the study seeks to examine students' responses to digital library use and to identify institutional strategies that can optimize their implementation. The results are expected to provide practical insights for integrating digital libraries into elementary curricula, thereby promoting digital literacy, innovative pedagogy, and sustainable educational development.

2. METHODOLOGY

2.1. Research Design

This study employed a qualitative descriptive design to examine the role of digital libraries in curriculum transformation in elementary education. This approach was selected to capture teachers' and educators' experiences in naturally integrating digital library resources into teaching and learning practices (Creswell, 2018). The study focused on how digital libraries are utilized to support instructional activities, facilitate curriculum flexibility, and encourage pedagogical innovation, as well as the challenges encountered during their implementation. Data collection was guided by these focal issues and analyzed through thematic coding to identify patterns related to digital access, teacher readiness, and institutional support. Overall, this design enabled a concise yet comprehensive understanding of digital libraries as instruments for curriculum reform at the elementary level.

2.2. Participants of the Study

The participants of this study consisted of five elementary school teachers who had prior experience using digital libraries in their instructional and curriculum development activities. They were selected because of their familiarity with digital platforms and their active involvement in integrating technology into classroom

practices. This background ensured that the participants could provide relevant insights into the role of digital libraries in curriculum transformation.

The study employed purposive sampling, which is a non-probability sampling technique where participants are deliberately chosen based on specific inclusion criteria that align with the research objectives. This approach allowed the researcher to focus on individuals who possess direct and meaningful experience related to the phenomenon under study. By selecting information-rich cases, the data collected could more accurately reflect practical applications and challenges encountered in real educational settings.

The inclusion criteria required that participants had firsthand experience integrating digital libraries into their teaching or curriculum activities. They were also expected to demonstrate a clear understanding of how these platforms support learning outcomes and curriculum implementation. In addition, participants agreed to take part voluntarily in in-depth interview sessions, ensuring ethical participation and informed consent throughout the research process.

A total of five participants were considered sufficient to reach data saturation, meaning that no new themes emerged from additional interviews. The selected teachers represented diverse subject areas and varied years of teaching experience, offering multiple perspectives on the integration of digital libraries across different learning contexts. This diversity enriched the findings and provided a more comprehensive understanding of how digital libraries contribute to curriculum innovation in elementary education.

2.3. Instruments

Data were collected using semi-structured interview guides, which allowed flexibility for participants to elaborate on their experiences while ensuring consistency across interviews. The interview protocol comprised six to eight open-ended questions aligned with the research objectives. Sample guiding questions included:

1. How do you utilize the digital library in your teaching process?
2. How does the digital library support curriculum development or adaptation in your class?
3. What are the challenges in integrating digital libraries into learning activities?
4. How do students respond to digital library–based learning?
5. What strategies can schools implement to optimize digital library usage?

Interviews were conducted online via Google meets,. Each session lasted approximately 30–45 minutes and was audio-recorded with the participants' consent. The recordings were then transcribed verbatim for analysis. Prior to data collection, participants provided informed consent, and ethical principles such as confidentiality and voluntary participation were strictly maintained.

2.4. Data Analysis Techniques

The collected data were analyzed using thematic analysis, following the six-phase framework proposed by Braun and Clarke (2006). This method was selected for its systematic yet flexible approach to identifying, analyzing, and reporting patterns within qualitative data. The steps included:

a) Data Familiarization: reading and re-reading the transcripts to gain an overall understanding.
b) Generating Initial Codes: labelling significant ideas and statements relevant to the research questions.
c) Searching for Themes: grouping similar codes into broader categories representing key ideas such as access, digital literacy, and curriculum relevance.
d) Reviewing Themes: refining and validating the emerging themes.
e) Defining and Naming Themes: clearly articulating each theme's essence and scope.
f) Producing the Report: integrating thematic findings with supporting literature and theoretical perspectives.

To ensure trustworthiness and validity, the study employed several verification strategies:

a) Triangulation through comparison of participants' responses and researcher interpretations.
b) Member checking by sharing preliminary findings with participants to confirm accuracy.
c) Peer debriefing to enhance analytical rigor and credibility.

The final themes were synthesized to construct a comprehensive understanding of how digital libraries contribute to curriculum transformation in elementary education.

3. RESULT AND DISCUSSION

The results section is the central component of a scientific article because it presents the main findings of the study. This section focuses on reporting the final outcomes without including detailed explanations of the data analysis process. It highlights what the study discovered in direct response to the research objectives or hypotheses. A clear and well-structured results section helps readers understand the essential contributions of the research.

In addition to written descriptions, research results are often supported by tables, figures, or graphs. These visual tools help clarify the findings and make complex data easier to interpret. They also strengthen the credibility of the study by visually demonstrating trends, relationships, or comparisons within the data. Therefore, combining narrative explanations with visual representations is considered good academic practice.

The findings of this study were derived from thematic analysis of interview data collected from five elementary school teachers. Each participant provided insights into their experiences with digital libraries in teaching and curriculum-related activities. The data were coded and analyzed to identify recurring ideas and meaningful patterns that represent shared perspectives. This process resulted in a set of key themes describing how digital libraries contribute to curriculum transformation.

The thematic analysis identified three main themes that reflect the central findings of this study. The first theme highlights how digital libraries enhance access to diverse and flexible learning resources. The second theme describes how digital libraries support curriculum adaptation and innovation. The third theme focuses on the importance of digital literacy and institutional support for effective integration.

Each of these themes captures a different dimension of how digital libraries influence teaching and learning processes in elementary education. Together, they illustrate the complex relationship between digital resource use, teacher readiness, and curriculum change. The results also suggest that digital libraries can serve as both tools and catalysts for educational transformation. These findings provide a foundation for further discussion and analysis. These themes are discussed below, along with their implications for curriculum transformation in elementary education.

Theme 1: Digital Libraries Enhance Access to Diverse and Flexible Learning Resources

All participants emphasized that digital libraries significantly broaden access to learning materials beyond printed textbooks. Teachers reported that they use digital libraries to enrich lesson content, assign exploratory tasks, and support differentiated learning. One teacher stated that “students with different abilities can choose readings that match their level,” while another noted that “using multimedia resources makes learning more engaging, especially for visual learners.”

These findings indicate that digital libraries promote equity and flexibility in learning by enabling teachers and students to access various formats such as texts, videos, and interactive media based on their learning needs. This supports Alvarez’s (2020) view that digital libraries are not merely repositories but dynamic learning ecosystems that enhance student autonomy and encourage self-directed learning. Furthermore, the increased access aligns with the principles of 21st-century education, where digital competence and information literacy are fundamental skills (UNESCO, 2018). By fostering the ability to navigate and evaluate diverse information sources, digital libraries contribute to developing critical thinking and independent learning—core outcomes of curriculum transformation.

In addition, participants highlighted that the integration of digital libraries also fosters collaborative learning among students. Several teachers shared that students

often work together to explore online resources, discuss digital texts, and share multimedia materials through classroom platforms. This collaborative engagement not only enhances their understanding of subject matter but also strengthens communication and teamwork skills. In this way, digital libraries do not only serve as individual learning tools but also as catalysts for interactive and social learning experiences that align with the goals of modern, student-centered pedagogy.

Theme 2: Digital Libraries Facilitate Curriculum Adaptation and Innovation

Participants consistently described digital libraries as essential tools that allow teachers to adapt and update curriculum materials in response to contemporary developments. One participant explained that "digital library helps us align the curriculum with current issues because its sources are always updated." Others added that digital libraries support flexible teaching approaches and reduce dependence on static textbooks.

This theme reflects that digital libraries act as mediators of curriculum transformation, enabling dynamic, contextualized, and innovative teaching practices. Teachers can easily integrate updated publications, multimedia content, and local resources into lessons, thereby enriching the curriculum and promoting relevance (Sipayung, Hernawan, & Fadlillah, 2025). These results are consistent with Fullan's (2007) argument that meaningful curriculum change requires ongoing access to current and relevant educational resources.

Moreover, digital libraries encourage collaborative and student centered learning, where students engage with digital content independently or in groups. This aligns with constructivist learning theories (Piaget, 1972; Vygotsky, 1978), which emphasize that knowledge is constructed actively through exploration and interaction. Consequently, the integration of digital libraries supports a pedagogical shift from teacher centered instruction toward facilitation of learning, marking a fundamental component of curriculum transformation in the digital era.

Theme 3: Digital Literacy and Institutional Support as Key Challenges

Although teachers acknowledged the positive impact of digital libraries, they also highlighted several barriers that hinder optimal use. These challenges include unstable internet connections, limited collections aligned with the national curriculum, insufficient digital training for teachers, and low digital literacy among students. One teacher mentioned that "some colleagues are not yet confident using the digital library," while another observed that "students often struggle to judge which sources are reliable."

These challenges underscore that technological and human readiness remain critical prerequisites for digital transformation in education. Access alone is not

sufficient; systematic efforts to build digital competence are necessary. Coman et al., (2020) emphasizes that teachers' and students' digital literacy determines the success of technology integration, while UNESCO (2019) highlights the importance of professional development and robust infrastructure in digital learning ecosystems. Without aligning these elements, technology adoption risks becoming superficial and unsustainable.

Participants proposed several strategies to address these barriers, including regular digital literacy workshops, improved internet access, and development of localized digital content. These recommendations are consistent with Iqbal and Omeluzor et al., (2023) assertion that effective digital library implementation requires policy support, contextualized content, and sustainable digital resource management. Such collaborative and policy-driven approaches can ensure that digital initiatives genuinely enhance teaching and learning outcomes.

Overall, the findings demonstrate that digital libraries play a transformative role in elementary education by expanding equitable access to diverse learning resources, supporting flexible and adaptive curriculum implementation, and emphasizing the importance of digital literacy and institutional support. When these three dimensions are effectively integrated, digital libraries function not merely as information repositories but as dynamic catalysts for educational reform, bridging the gap between traditional and digital learning environments. The success of this transformation, however, depends on several interrelated factors, including equitable access to technology, the digital competence of teachers and students, and the sustained institutional commitment to digital integration. With these conditions in place, digital libraries possess the potential to significantly advance curriculum transformation and nurture a culture of lifelong learning among young learners in the digital era.

4. CONCLUSION

This study concludes that digital libraries constitute a strategic enabler of curriculum transformation in elementary education. The findings demonstrate that digital libraries significantly enhance equitable access to diverse learning resources, support flexible and adaptive curriculum implementation, and strengthen digital literacy among teachers and students. These results directly address the research objectives by confirming that digital library integration extends beyond resource provision to facilitate pedagogical renewal, particularly through inquiry-based learning, collaborative practices, and the development of 21st-century competencies.

From a theoretical perspective, this study contributes to curriculum transformation discourse by positioning digital libraries as mediating tools that bridge curriculum policy, pedagogical practice, and digital literacy development at the elementary level. Practically, the findings highlight how teachers' instructional

strategies and curriculum enactment evolve when supported by accessible digital resources. At the policy level, the study underscores the necessity of formal institutional frameworks that recognize digital libraries as integral components of curriculum delivery rather than optional supplements.

However, the findings also reveal persistent challenges, including inadequate technological infrastructure, varying levels of digital literacy among teachers and students, and limited institutional policies governing systematic digital library use. These constraints reduce the transformative potential of digital libraries and risk perpetuating unequal access and inconsistent pedagogical practices across schools.

Based on these findings, it is recommended that policymakers and educational institutions prioritize investment in digital infrastructure and formally embed digital library utilization within curriculum frameworks and school policies. Schools should implement sustained professional development programs focused on digital pedagogy, instructional design using digital resources, and ethical information literacy. Additionally, curriculum developers should ensure alignment between digital library content, national curriculum standards, and local educational contexts to enhance relevance, accessibility, and instructional coherence.

This study is limited by its focus on a single educational level and a relatively small participant group, which may constrain the transferability of the findings. Future research is therefore encouraged to involve broader and more diverse educational contexts and to employ mixed-method approaches to examine the impact of digital library integration on student learning outcomes. Comparative studies across different digital library platforms or institutional models may also yield deeper insights into contextual and systemic variations.

Overall, this study affirms that when strategically integrated, digital libraries hold substantial potential to drive curriculum innovation, promote inclusive learning environments, and support sustainable educational transformation. Their effective use can strengthen digital literacy, critical thinking, and collaborative learning, thereby contributing to the development of future-ready elementary education systems.

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Bibliometric Analysis of Digital Learning in Writing Skills

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ABSTRACT

The application of digital media in education has completely changed the way students develop writing skills. However, understanding of global research trends in this field is still limited. Therefore, this study aims to address the gap by mapping the scientific landscape of digital media use in improving writing skills. This study uses bibliometric analysis and visualization methods. Data were obtained from the Scopus database. Data analysis utilized VOSviewer, Publish or Perish, and Microsoft Excel software to identify publication trends, geographical distribution, relationships between countries, journal distribution, research focus, and citation trends. There are 116 publications from 2016 to 2025 that meet the criteria. The research results show the highest increase in publications in 2025 with 51 articles. The United States has the highest volume of publications and international collaborations. The most influential publication source is the work of M.M Naeuman (2018). The Journal of Education and Information Technology is one of the most frequently cited publications. The research focus indicates that the most frequently occurring keywords are "teacher," "education," "teaching," "digital tools," "professional development," "leadership," and "collaboration," which highlights the main focus of the research. Overall, this research provides a comprehensive overview of the development, influential contributors, and research directions in this field.

Keywords: *Anlyze, Digital, Skill, Technology, Writing.*

1. INTRODUCTION

The teaching and learning process is an interactive communication process carried out to achieve predetermined goals (Ansoriyah, 2020). One important goal of learning is to produce individuals who can convey their ideas, both orally and in writing, with good structure and logic. That ability is closely linked to language skills. According to Permendikbud No. 24 of 2016 regarding Core Competencies and Basic Competencies for 2013, there are four aspects of language skills: speaking, listening, reading, and writing (Situmorang, 2018). Although all four components have equal importance, most students experience difficulties in writing ability (Zulkarnaini, 2011) as cited in (Suprayogi et al., 2021). More than that, a survey of Indonesian language teachers showed that the least favorite Indonesian language lesson for both teachers and students is writing instruction. In fact, language skills are one of the essential requirements in today's industry (Suprayogi & Budi Eko, 2020)

Language is never separate from human social life. Language allows humans to communicate effectively and convey ideas, thoughts, and information (Hoerudin, 2023). As social beings, language skills are an important aspect that every individual needs to

possess. By mastering language skills, the quality of communication will improve, making social interactions more effective. According to (Sihombing et al., 2024) define language skills as the ability to use language effectively and accurately, both orally and in writing. Students' language skills can be improved thru various literacy activities integrated with subjects, as literacy provides opportunities for students to hone their language skills more deeply. Increased literacy activity has a positive impact on improving the four language skills: reading, speaking, listening, and writing (Sulatra et al., 2021). The literacy movement can be implemented in various subjects relevant to the curriculum (Najwa, 2018).

Writing has always been the most difficult part of classroom learning (Yunus et al., 2019). Previous research indicates that only 0.8% of the total respondents are interested in writing. However, in the current situation, it is important for every individual to be able to express their thoughts and feelings in writing. Additionally, having good writing skills will positively strengthen the character and potential of Indonesia's human resources. For this reason, writing instruction should be developed from primary education (Astutik et al., 2021; Munajah et al., 2022). Writing instruction needs to receive attention and directed guidance from an educator so that when students encounter difficulties, the educator can provide direction.

Learning media can help educators in the process of delivering material so that it is easier for students to understand (Ulfah et al., 2023). Educators can utilize various types of learning media as needed. One of the learning media widely used in the Merdeka Curriculum is technology-based learning media, including digital learning media. Digital learning media is learning media that uses digital devices because its utilization requires digital data to produce digital images that can be processed, accessed, and distributed. By utilizing digital learning media, learning objectives are expected to be achieved optimally with an effective and efficient process (Ulfah et al., 2023). The use of digital-based media is more effective than other media or traditional education channels because information can be seen, heard, and carried out. In this case, the researcher will develop language learning, specifically aspects of writing stories for lower-grade students in elementary schools (Munajah et al., 2022). Information and communication technology must be utilized as a tool for storing information and publishing various content that can be accessed by the international community. Every journal published must be responsible for the content and authenticity of its content. This indicates that writing skills and proficiency in using ICT (Information and Communication Technology) are closely interconnected in the 21st century. Writing is also a process of critical and creative thinking, as it involves analysis in choosing the right words and developing new ideas. Therefore, it is important for education to pay special attention to developing technology-supported writing skills (Saputra et al., 2021).

The rapid development of digital media in education has fundamentally changed how students develop their writing skills, even though digital technology has become widely used in various aspects. Understanding of research trends related to the use of digital tools in developing narrative writing skills is still limited.

Research related to digital media in writing instruction has been widely conducted. Consequently, a study that looks at these studies' findings is required. One technique that can be applied is bibliometric analysis. Research findings in particular domains, like education, can be examined using bibliometric analysis (Muhammad et al., 2022; Sanusi et al., n.d.; Triansyah & Supardi, 2023). The following are the goals of this study: 1) To document the state of research on digital tools for improving writing abilities between 2016 and 2025. 2) To determine the most recent publication and citation patterns pertaining to the use of digital technologies for improving writing abilities. 3) To ascertain patterns of relationships between nations and the geographic distribution of publications. 4) To determine the most cited papers and the area of study.

2. METHODOLOGY

2.1. Research Design

The methodical gathering, measurement, and analysis of data in accordance with the research topic is made possible by the bibliometric analysis strategy used in this study (Muhammad et al., 2022). Important techniques are used in bibliometric research to analyze publications on particular topics both statistically and qualitatively (Abouzid et al., 2021). The bibliometric visualization approach is used in this work. The structural overview of a particular topic of study is displayed using the bibliometric visualization method (Garfield, 2009) in (Sanusi et al., 2023). Both bibliometric analysis and bibliometric visualization are used in this study.

2.2. Participants of the Study

Identification, screening, eligibility, and inclusion are some of the steps in the data gathering process (Siregar et al., 2023). According to (Moher et al., 2009) in (Muhammad et al., 2023), a number of procedures must be completed in order to refine data collecting, including: 1) identification; 2) screening; 3) eligibility; and 4) inclusion. Entering the relevant keywords into the Scopus database allowed for identification. The study's keywords were "Digital tools" and "Writing skill development." The researcher found 259 papers that satisfied the requirements as a result of this procedure. After that, the researcher used the following standards to filter the publications:1) Publications must be written in English; 2) They must be articles; 3) The researcher must have chosen publications from 2016 to 2025; 4) They must be of the document type; and 5) The source must be a journal. There were 116 publications that satisfied

these requirements. The documents' abstracts and titles were examined to see if they included digital learning in order to evaluate eligibility. Following this procedure, 116 papers that satisfied the predetermined standards were added to the subsequent phase.

The researcher employed a number of auxiliary programs, including Microsoft Excel, VOSviewer, and Harzing's Publish or Perish software, to analyze the data. The purpose of the analysis was to provide answers to the research questions. The resulting data was then saved in RIS and CSV format. RIS data was used to view publication trends and citation trends using Harzing's Publish or Perish software. CSV data was used to view the geographical distribution mapping, patterns of international collaboration, and research focus using the VOSviewer application. Publication trends were viewed based on the year of publication, displayed with the help of Microsoft Excel software. Citation trends were calculated from the highest number of citations. The geographical distribution mapping was displayed on a flat map to clearly show the distribution, with the help of Microsoft Excel software. The patterns of cooperation between countries are presented to show the relationships between them. The research focus was analyzed from the Network visualization and Overlay visualization displays. The novelty of the research can be seen from the interconnectedness of the keywords presented.

2.3. Research Subjects

The sample for this study consists of 116 publications obtained from digital data tools and writing skills.

2.4. Data Analysis Techniques

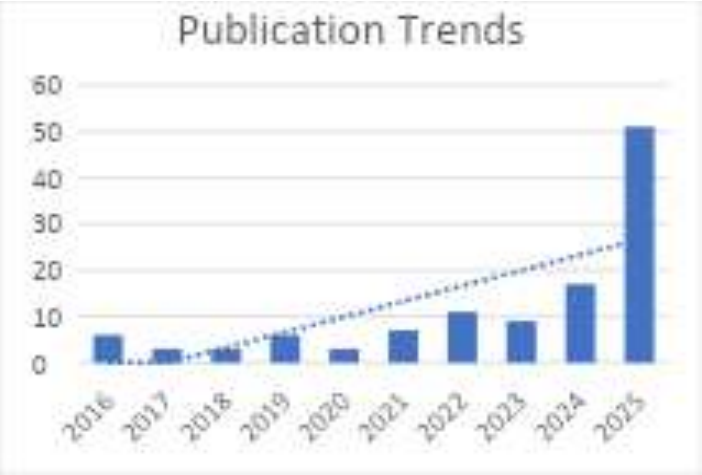
The data analysis technique used is deductive, starting from general findings and moving toward more specific ones, such as: publication trends, geographical distribution of publications, distribution of publication collaboration patterns, distribution of publication journals, citation trends of bibliographic pairs in publications, and co-occurrence of author keywords, so that readers follow the information provided from general to more specific (Ersozlu & Karakus, 2019).

3. RESULT AND DISCUSSION

3.1. Publication Trends

The review of publication years in bibliometric studies aims to understand the development of research related to a specific topic year by year. A search on Scopus using the keywords "digital learning" and "writing skills development" over the past 10 years found 116 articles. Based on Figure 1, the data trend for scientific publications

related to digital learning in writing skills indexed in Scopus shows a fairly fluctuating development.



Source: Data processing 2025

Figure 1. Development of Scopus Data Source Publication

In the early period of 2016 to 2025, the number of publications was still relatively low and stable, averaging only about 4-6 articles per year. From 2021 to 2023, there was a noticeable increase, with the number of articles reaching 7-9 publications per year. A significant increase was seen in 2024 with 17 articles or (14.29%), and this continued to increase in early 2025 with a total of 51 publications, equivalent to 47.62% of the total publications. This proves that research on technology-based learning in writing materials remains a topic of interest to many researchers to this day. The publication trend from year to year shows that research and publication activities have experienced very rapid development in the last two years. This increase is due to the growing interest in research, supported by institutional or academic encouragement in related fields.

3.2. Geographic Distribution

Figure 2 shows the trend in research productivity across 74 countries. Data shows that over the period from 2016 to 2025, the United States dominates in terms of the number of publications, with a total of 15 publications in 2025, followed by Saudi Arabia with 14 publications and Spain with 12 publications. Turkey had 11 publications and China had 10 publications. Countries with strong educational infrastructure, significant research funding, and a thriving academic tradition will produce more publications in reputable international journals. At the intermediate level, countries like Malaysia with 8 publications, Thailand, Indonesia, and Australia with 7 publications each, demonstrate active research. Indonesia is included in the productive group in Southeast Asia. Other countries with fewer publications, such as Zumbia, Uzbekistan,

Moldova, Slovenia, and others, each produced 1 publication. Here are some public publications related to the keywords that have been set in several countries.

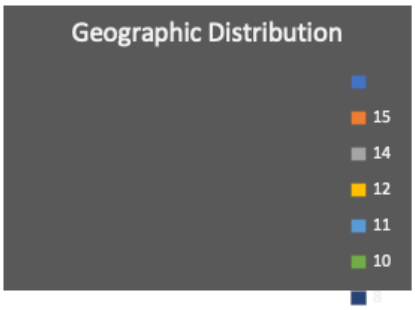


Figure 2. Geographic Distribution

The image above illustrates that the publications are distributed across the Americas, Asia, Europe, Africa, Australia, and almost all continents contribute to publications related to digital tools in writing skill development.

3.3. Relations in International Cooperation Patterns

The relationships between countries in this publication are shown in several color clusters, representing closely connected collaboration groups. Each color illustrates a different pattern of cooperation based on the intensity of the relationships between countries within a cluster. Here is an image of the relationship between countries in Figure 3.

Figure 3. Relations in International Cooperation Patterns

The red color cluster, centered on the American countries, illustrates the strong collaborative network between the United States, Canada, the United Kingdom, Turkey, Switzerland, and Australia. Thus, these countries have an intensive relationship with the United States as the main link for other countries. The yellow-green cluster is located around Middle Eastern and Western Asian countries, such as Saudi Arabia and the United Arab Emirates, both of which have strong collaborative relationships with countries like Australia and Hong Kong. Saudi Arabia's position as a network center in Western Asia and a component of a cross-continental network that connects to East Asia and Australia is highlighted by this pattern of collaboration. The green and blue

clusters, which include nations like Indonesia, Malaysia, and Spain, constitute an alliance between Asia, Europe, and Southeast Asia.

This indicates significant transregional collaboration. Overall, Figure 3 above shows that the pattern of international publication collaboration is not only centered on one continent or region, but forms a cross-continental network involving the Americas, Europe, the Middle East, Asia, and Australia. However, based on the network of international cooperation shown in this publication, it can be seen that the United States emerges as the largest and most connected hub. The United States is the most central country on the collaboration map, indicating the highest frequency and diversity of cooperation compared to other countries in the network presented.

3.4. Journal Distribution

Based on the search results using the keywords "digital tools" and "writing skill development" with the categories of article title, abstract, and keywords within the period of 2016 – 2025 on Scopus, 116 publications were obtained. The distribution results of the journals can be seen in Table 2 below.

Table 1. Distribution of Journals

Name of Journal	Document	Citation
Arab Word English Journal	3	0
Fronties in psychology	3	95
International journal of learning, teaching	2	0
Plos one	2	42
Reading and writing	3	8
Word journal of english language	3	4
Computer assisted language learning	4	120
Computers and education	4	355
Education and information tecnology	5	8
Educational process: international journal	2	28
Journal of computer assited learning	2	44
Medical writing	2	3
Sustainability (Switzerland)	2	4
Theory and practice in language	2	6

The articles included as part of the analyzed data and widely cited by other scientific articles are those published in the Journal Computers and Education and the journal Computer Assisted Language Learning, receiving 355 and 120 citations respectively. Meanwhile, journals that publish many articles related to digital learning in other writing skills include the Arab Word English Journal (3 documents, 0 citations), the journal Frontiers in Psychology (3 documents, 95 citations), the International Journal of Learning, Teaching (3 documents, 0 citations), Plos One (2 documents, 42 citations),

Reading and Writing (3 documents, 8 citations), Word Journal of English Language (3 documents, 4 citations), Education and Information Technology (3 documents, 4 citations), Education and Information Technology (5 documents, 8 citations), Educational Process: International Journal (2 documents, 8 citations), Journal of Computer Assisted Learning (2 documents, 44 citations), Medical Writing (2 documents, 3 citations), Sustainability (Switzerland) (2 documents, 4 citations), and Theory and Practice in Language (2 documents, 6 citations).

3.5. Research Focus

In the process of reviewing research trends on digital tools and writing skills development, the division of clusters in the diagram is crucial for identifying them (Mazov et al., 2021) in (Muharram et al., 2025). In network visualization, each keyword is represented by a colored circle. The size of the circle for a keyword is determined by the weight of each keyword. The higher the weight of an item, the larger the circle for that item (Pesta et al., 2018). By detecting phrases that exhibit notable shifts in their frequency over time, they can even reveal which study topics in a field are popular (or less so). The findings of keyword mapping employed by researchers in scientific papers about the growth of writing skills and digital technologies between 2016 and 2025 are displayed in Figure 4. Seven cluster sections are used out of the 116 articles that Scopus has indexed.

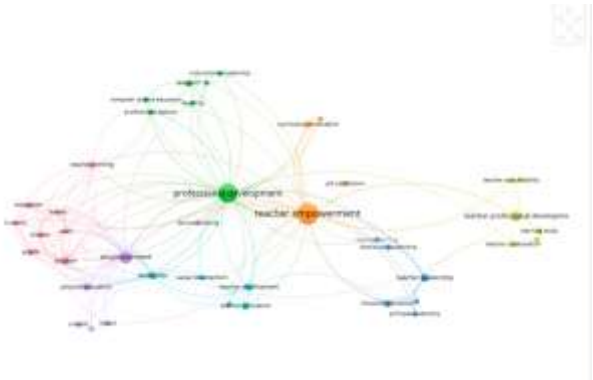


Figure 4. Research Focus

The connections between terms that exist in the literature pertaining to "digital tools" and "writing skills development" from scientific databases are depicted in the network visualization in Figure 5. Keywords are represented by nodes (circles) in the network visualization diagram, while connections to other scientific articles are shown by the lines that connect the nodes. 42 keywords in all are shown, divided into seven groups according to topic and research relationship.

Different colors are used to identify these clusters, which represent various yet related research areas. The first cluster, which has eight items and is red, highlights the elements of "adult, article, education, female, human, humans, teacher, teacher

training," suggesting that this subject is a major priority when it comes to using digital tools to improve writing abilities. The second cluster, which has seven components and focuses on "computer science education, professional aspects, teaching, teachers, teaching, and instructional leadership," shows how technology and teacher professional development are related. The third cluster, which has six items and is blue, focuses on the elements of "distributed leadership, inclusive education, principal leadership, relationship between leadership attributes, teacher leadership, teaching learning," suggesting that one of the key elements in the development of writing skills is a leadership approach. A collaborative and evaluative learning approach is highly relevant to the context of digital learning, as evidenced by the fourth cluster, which is yellow (6 items) and focuses on the elements of "learning study, teacher accountability, teacher collaboration, teacher evaluation, teacher professional development, and variation theory''. The fifth cluster is purple (6 items) and focuses on the aspects of "decision making, empowerment, physical education, school, schools, teachers." This indicates that the school context and teacher empowerment are a major focus in developing writing skills. The sixth cluster is light blue (5 items), with the main focus on the aspects of "career development, challenges, leadership, teacher development, and teacher education." This indicates that teacher development is an important issue in the context of digital learning tools. The seventh cluster is orange (4 items), emphasizing the aspects of "chemistry teachers, curriculum innovation, job satisfaction, and teacher empowerment." This shows that innovation and teacher satisfaction are supporting factors in developing writing skills.

3.6. Quotation Trend

Table 2. Quotation Trend

Cites	Authors	Title	Year	Source
157	M.M. Neumann	Using tablets and apps to enhance emergent literacy skills in young children	2018	Early Childhood Research Quarterly
131	C. Williams, S. Beam	Technology and writing: Review of research	2019	Computers and Education
124	T. Asselborn, T. Gargot, Å. Kidzinski, W. Johal, D. Cohen, C. Jolly, P. Dillenbourg	Automated human-level diagnosis of dysgraphia using a consumer tablet	2018	npj Digital Medicine
111	S. Wollscheid, JÃ¸. Sjaastad, C. TÃ¸mte	The impact of digital devices vs. Pen(cil) and paper on primary school students' writing skills - A research review	2016	Computers and Education

Cites	Authors	Title	Year	Source
105	K. Hava	Exploring the role of digital storytelling in student motivation and satisfaction in EFL education	2021	Computer Assisted Language Learning
105	M.M. Neumann, G. Finger, D.L. Neumann	A Conceptual Framework for Emergent Digital Literacy	2017	Early Childhood Education Journal
100	M.M. Neumann	Young children's use of touch screen tablets for writing and reading at home: Relationships with emergent literacy	2016	Computers and Education
73	K. Alexander, C. Savvidou, C. Alexander	Who Wrote This Essay? Detecting Ai-Generated Writing In Second Language Education In Higher Education	2023	Teaching English with Technology
60	J. Guilbert, D. Alamargot, M.-F. Morin	Handwriting on a tablet screen: Role of visual and proprioceptive feedback in the control of movement by children and adults	2019	Human Movement Science
57	C. Mayer, S. Wallner, N. Budde-Spengler, S. Braunert, P.A. Arndt, M. Kiefer	Literacy Training of Kindergarten Children With Pencil, Keyboard or Tablet Stylus: The Influence of the Writing Tool on Reading and Writing Performance at the Letter and Word Level	2020	Frontiers in Psychology

Articles with the keywords “digital tools” and “writing skill development” from 2016 to 2025 contain seven references that have been cited at least 100 times. The publication with the most citations is Neumann (2018) with the title “Using tablets and apps to enhance emergent literacy skills in young children,” which has been cited 157 times. Next, the second most cited publication is from (Williams & Beam, 2019) with the title “Technology and writing: Review of research,” which has been cited 131 times. The article "Automated human-level diagnosis of dysgraphia using a consumer tablet" by Asselborn et al. (2018) is the third most cited. With 111 citations, "The impact of digital devices vs. Pen(cil) and paper on primary school students' writing skills – A research review" by Wollscheid et al. (2016) is the fourth most cited publication. With 105 citations, Hava's (2021) paper "Exploring the role of digital storytelling in student motivation and satisfaction in EFL education" is the fifth most cited. With 105 citations, Neumann et al. (2017)'s "A Conceptual Framework for Emergent Digital Literacy" is the sixth most cited article. Neumann (2016), "Young children's use of touch screen tablets

for writing and reading at home: Relationships with emergent literacy," has received 100 citations, making it the seventh most referenced publication.

4. CONCLUSION

Based on the results of a bibliometric analysis conducted on the development of research and scientific publications related to digital tools in writing skills development, it was found that there was a significant increase in the number of publications examining this theory during the period 2016 to 2025. The year 2025 saw the highest number of publications, with 51. The study shows that authors from the United States are among those with the highest number of publications. Although the United States remains the country with the highest number of publications, researchers from Saudi Arabia experienced a sharp increase in their research productivity in 2023. The most frequently cited references in research and scientific publications related to digital tools and writing skill development are the works of Neumann (2018) and Williams & Beam (2019). Both are considered the main foundation in the development of digital tools in writing skills development, with many researchers referring to these works to build a further understanding of how the use of digital tools can improve writing skills development. In this case, these two articles are very important sources in the context of digital tools and writing skill development used in various disciplines. In addition, the journals that publish the most articles related to attribution theory are the journals Education and Information Technology, Computer Assisted Language Learning, and Computers and Education, which are the most cited journals among researchers writing about digital tools and writing skill development. This shows that digital tools are widely applied in educational research contexts.

From the keyword mapping, seven main clusters were identified that reflect various topics frequently discussed in research and publications related to digital tools and writing skill development. The first cluster consists of 8 items marked in red with the keywords “adult, article, education, female, human, humans, teacher, teacher training.” The second cluster consists of seven items marked with green circles with the keywords “computer science education, professional aspects, teaching, teachers, teaching, and instructional leadership.” The third cluster consists of six items marked with blue circles with the keywords “distributed leadership, inclusive education, principal leadership, relationship between leadership attributes, teacher leadership, teaching learning.” The fourth cluster is marked with a yellow circle with the keywords “learning study, teacher accountability, teacher collaboration, teacher evaluation, teacher professional development, and variation theory.” The fifth cluster consists of 6 items marked with a purple circle with the keywords “decision making, empowerment, physical education, school, schools, teachers.” The sixth cluster consists of five items marked with a light blue circle with the keywords “career development, challenges,

leadership, teacher development, teacher education." The sixth cluster consists of five items marked with bright blue circles with the keywords "career development, challenges, leadership, teacher development, teacher education." The seventh cluster consists of four items marked with orange circles with the keywords "chemistry teachers, curriculum innovation, job satisfaction, and teacher empowerment." Overall, the results of this analysis show that research in this area contributes to and broadens our understanding of effective ways to encourage the development of writing skills through technology. This encourages practical implications in strengthening teachers' digital competencies, adjusting the curriculum, and developing creative and inclusive writing learning strategies in line with the direction of global digital-based education development.

The practical implications of this article provide a broad overview of research trends and developments in scientific publications related to digital tools and writing skills in the period from 2016 to 2025. The main findings show, first, that the use of digital tools in the development of writing skills must be supported by comprehensive teacher training, especially in the context of inclusive education and instructional leadership. second, collaborative and evaluative approaches to learning are very important for improving students' writing skills, especially in a digital context. Third, curriculum innovation and teacher empowerment are key supporting factors in the development of writing skills, especially in the context of digital tools. However, there are several limitations that should be noted. First, this analysis only covers publications indexed in Scopus, which means that not all relevant journals are included in this study. This may limit the scope of the research, given the possibility that important publications are not listed in the database. Second, although bibliometric methods provide a useful quantitative overview, this study does not investigate in depth the methodological quality of each publication analyzed.Thus, despite the apparent trend, the quality and substantive impact of the research cannot yet be fully understood. uture studies should conduct longitudinal experiments testing digital tools' impact on diverse learner demographics, particularly in non-Western contexts beyond the U.S. and Saudi Arabia. Comparative analyses across clusters, such as integrating teacher leadership (Cluster 3) with professional development (Cluster 6), could explore causal mechanisms. Additionally, investigate underrepresented areas like AI-driven tools or inclusive strategies for neurodiverse students to address gaps in current keyword mappings and advance evidence-based curriculum reforms.

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High Tech, Low Touch: The Interaction Paradox in Post-Pandemic Hybrid Pedagogy

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ABSTRACT

The post-pandemic era cemented hybrid learning as a key curriculum innovation. While offering flexibility, its success in higher education hinges on effective digital pedagogy and student perception. This study addresses this by providing a comprehensive evaluation of student perceptions within an Educational Technology program, offering a holistic view of the current hybrid model's effectiveness. This research holistically analyzes perceptions of active students across all cohorts regarding digital pedagogy in the hybrid environment. It examines key dimensions (content delivery, interaction, collaboration, flexibility) to identify overarching challenges and advantages, ultimately providing evidence-based recommendations for curriculum innovation. This descriptive survey used a quantitative approach. The sample consisted of 88 active students from the Educational Technology Program. Data was collected via a validated questionnaire and analyzed using descriptive statistics (percentage) to map overall perceptual trends. The descriptive analysis reveals a critical pedagogical disconnect. Despite students perceiving 'student readiness' (81.8%) and 'lecturer competence' (80.7%) as the top factors supporting success, the single greatest obstacle identified was 'lack of student interaction' (83.0%). This was followed by technical barriers, with 'internet quality' (79.5%) also cited as a major hindrance. This suggests that while individual components (students, faculty) are strong, the current hybrid model struggles to facilitate the pedagogical-social connections essential for learning. Understanding this holistic student perspective is essential for refining digital pedagogy. The findings provide actionable insights for faculty and curriculum designers to create a hybrid environment that is not only flexible but also truly meaningful and supportive, contributing to sustainable curriculum transformation.

Keywords: *Curriculum Innovation, Digital Pedagogy, Hybrid Learning, Student Interaction, Student Perception.*

1. INTRODUCTION

After more than four years since the COVID-19 pandemic, hybrid learning has become the new standard in global education systems, including in Indonesia. This model combines the advantages of face-to-face interaction with the flexibility of online learning, allowing students and educators to adjust their time, place, and learning styles. Studies have shown that hybrid learning has been effectively implemented, with students successfully achieving instructional goals (Rusyada & Nasir, 2022) and showing increased learning motivation (Hardanti et al., 2022).

However, flexibility does not solely equate to effectiveness. Effective learning demands deep interaction and student engagement. While much research has focused on infrastructure, the socio-pedagogical aspect is often overlooked. This leads to a phenomenon known as the "interaction paradox": a condition where the increased use

of technology paradoxically decreases the depth of human interaction in the learning process.

Despite efficient digital communication, studies report that interpersonal relationships become shallower, emotional engagement declines, and students feel awkward and unable to interact optimally (Rahmawati et al., 2023). This "low touch" phenomenon is not merely anecdotal; it is a documented challenge in high-tech pedagogy. Recent studies explicitly identify the "lack of social interaction" and the "possible loss of human connection" as significant negative impacts of technology-driven learning (Mim et al., 2025).

A systematic review by Otto et al. (2025) confirms this, cautioning that Generative AI (GenAI) may "reduce human-to-human interaction" and negatively impact the "critical social-emotional aspects of learning". The same review noted that GenAI applications predominantly focus on "individual usage," with "collaborative applications being notably rare", further exacerbating the "low touch" problem.

This issue becomes particularly critical within an Educational Technology program. On one hand, these students are expected to be the most adaptive to digital learning. On the other hand, they also require meaningful social interaction. While studies show students are generally positive about the flexibility of hybrid models, they also face significant challenges related to pedagogy and technology use (Raes et al., 2020).

Therefore, this research holistically analyzes the perceptions of active Educational Technology students regarding this paradox. This study aims to (1) analyze student perceptions of digital pedagogy, (2) identify key challenges in interaction and collaboration, and (3) specifically highlight the gap between high-tech readiness and the perceived "low-touch" or failure of pedagogical-social connections. The findings are essential for refining a hybrid environment that is not only flexible but also truly meaningful and supportive.

2. METHODOLOGY

2.1. Research Design

This study utilized a descriptive quantitative approach. The research design employed was a descriptive survey. This methodology was chosen as it is the most suitable for the study's objective: to provide a systematic and measurable overview of student perceptions regarding the implementation of hybrid learning and its impact on social interaction and pedagogical aspects. Instead of seeking causal relationships, this descriptive research focuses on mapping trends and identifying the actual conditions in the field, specifically to measure the "high tech" and "low touch" variables within post-pandemic hybrid pedagogy.

2.2. Participants of the Study

The population for this study comprised active students from the Educational Technology Program at Universitas Pendidikan Indonesia. The research sample consisted of 88 active students selected from various cohorts. The selection of participants from the Educational Technology program was purposive, based on the assumption that this group is the most adaptive to technology. Therefore, their perceptions of the "interaction paradox" are highly relevant and crucial to investigate.

2.3. Instruments

The primary data collection instrument was a validated questionnaire designed by the researchers. The questionnaire was distributed online using the Google Forms platform. The instrument was specifically designed to measure three key dimensions: (1) the level of technology utilization (high tech); (2) the frequency and quality of social interaction (low touch), including both faculty-student and student-student interactions; and (3) student perceptions of the application of pedagogical principles within the hybrid system. The questionnaire utilized a combination of a 1-5 Likert scale and multiple-choice questions to identify the most dominant supporting and hindering factors.

2.4. Data Analysis Techniques

All data collected from the 88 respondents were analyzed using descriptive statistics. This technique was used to process the quantitative data into concise and clear information. The data analysis focused on calculating frequencies and percentages to map overall perceptual trends. This analysis was used to identify the factors most dominantly perceived as supporters (e.g., 'lecturer competence', 'student readiness') and hindrances (e.g., 'lack of student interaction', 'internet quality') in the implementation of post-pandemic hybrid pedagogy.

3. RESULT AND DISCUSSION

This study analyzed the perceptions of 88 active students from the Educational Technology Program. The descriptive statistical analysis mapped the primary supporting factors and the main hindrances perceived by students in the post-pandemic hybrid learning environment.

The results show a clear consensus on the human components of the system. As shown in Table 1, the two most significant factors identified by students as supporting the success of hybrid learning were 'Student Readiness' (81.8%) and 'Lecturer Competence' (80.7%). This indicates a high level of confidence in the 'high tech' capabilities, the technical and pedagogical readiness, of both educators and learners within the program.

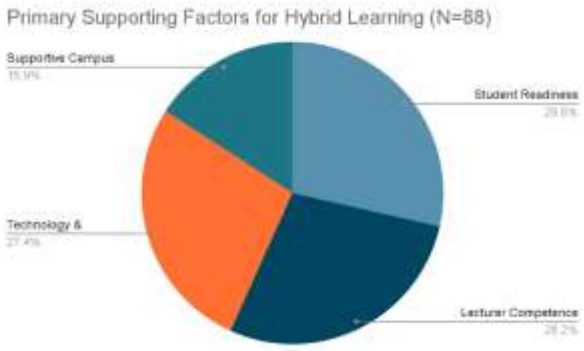

Figure 1. Primary Supporting Factors for Hybrid Learning

Conversely, when asked to identify the greatest hindrances, respondents pointed to both social and technical issues. As detailed in Table 2, the most significant obstacle identified was 'Lack of Student Interaction' (83.0%). This was followed by technical barriers, with 'Internet Quality' (79.5%) also cited as a major hindrance.

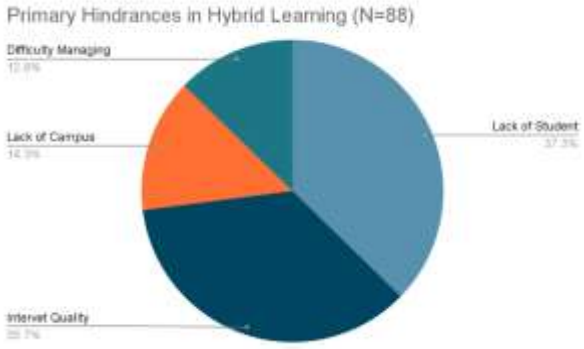

Figure 2. Primary Hindrances in Hybrid Learning

The findings of this study reveal a critical pedagogical disconnect, which we term the "High Tech, Low Touch" paradox. The data presents a stark contradiction: students report a very high level of readiness and competence from both themselves and their lecturers (81.8% and 80.7%, respectively), indicating that the High Tech components (human capability) are largely in place. However, they simultaneously report that the single greatest obstacle to their learning is a Low Touch component: 'Lack of Student Interaction' (83.0%).

This paradox, where technological readiness is high but human connection is failing, is a documented challenge in modern digital pedagogy. This finding strongly aligns with recent literature. For instance, a systematic review by Otto et al. (2025) on Generative AI in STEM education cautioned that such technologies may "reduce human-to-human interaction" and negatively impact the "critical social-emotional aspects of learning". The same review noted that GenAI applications predominantly focus on "individual usage," with "collaborative applications being notably rare", which mirrors

the "low touch" environment our participants are experiencing. Similarly, Mim et al. (2025) explicitly identified the "lack of social interaction" and the "possible loss of human connection" as significant negative impacts of technology-driven learning.

This paradox is particularly striking given the study's population: Educational Technology students. This is a cohort that, by definition, should be the most skilled and prepared to thrive in a high-tech learning environment. Their perception that the system is failing on a social level, despite their own technical readiness, suggests that the current hybrid model has prioritized logistical flexibility over pedagogical-social connection. The findings imply that while individual components (students and faculty) are strong, the curriculum design of the hybrid model struggles to facilitate the meaningful, collaborative interactions essential for deep learning.

4. CONCLUSION

This study concludes that the "High Tech, Low Touch" paradox is a significant and measurable phenomenon within the post-pandemic hybrid learning model. The findings confirm that while individual "high tech" components, such as student readiness (81.8%) and lecturer competence (80.7%), are perceived as strong, the current model is failing in the "low touch" dimension. The fact that 'lack of student interaction' (83.0%) is cited as the single greatest hindrance, surpassing even technical issues like internet quality (79.5%), demonstrates a critical pedagogical disconnect. The current implementation prioritizes logistical flexibility at the expense of essential pedagogical-social connections. Based on these findings, this study provides actionable insights for curriculum designers and faculty. It is recommended that the Educational Technology program shifts its focus from mere technological deployment to the intentional design of interaction. Curriculum innovation should not only be flexible but also truly meaningful and supportive. Practical suggestions include implementing structured collaborative projects, redesigning hybrid activities to mandate peer-to-peer engagement (Otto et al., 2025), and leveraging technology to facilitate, rather than replace, human connection (Mim et al., 2025) . This study contributes to sustainable curriculum transformation by emphasizing that a successful hybrid model must be both high tech and high touch.

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The Potential and Challenges of Artificial Intelligence (AI) in Special Needs Education: A Systematic Literature Review

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ABSTRACT

Inclusive education currently faces significant challenges because traditional learning models often fail to accommodate the diverse and unique characteristics of students with special needs. Therefore, this study aims to explore the potential, implementation, and challenges of artificial intelligence in supporting the learning of students with special needs. This study uses a qualitative approach with the Systematic Literature Review (SLR) method utilizing the PRISMA guidelines. The results show that AI technology has great potential in supporting the learning of students with special needs, such as helping to adjust learning materials and speed according to the needs of each student. In Indonesia, there is a gap in AI implementation between regions with advanced infrastructure and those with limited infrastructure. This is because the application of this technology still faces challenges that need to be addressed, such as teacher competency constraints, lack of infrastructure, and algorithmic bias that hinders access to inclusive education. This study emphasizes that although AI plays a role as a tool for educational transformation, the deep digital divide remains a major obstacle, requiring systemic improvements in infrastructure equity to realize its full potential.

Keywords: *artificial intelligence, assistive, inclusive, special needs, technology.*

1. INTRODUCTION

Education is a guaranteed right in Indonesia (Law No. 8/2016), which calls for a shift towards inclusive education. However, the traditional “one-size-fits-all” model often fails to accommodate students with disabilities. To bridge this gap, Assistive Technology (AT)—particularly AI-based systems—has emerged as a vital solution that offers personalized learning capabilities and can dynamically adapt to the unique needs of students.

Although the potential of AI has been proven through successful global interventions (Paglialunga & Melogno, 2025) and local prototypes such as “Dif-Able Apps” (Herviani et al., 2022), a significant gap still exists in Indonesia. Field studies reveal that its implementation is still far from high-tech; schools predominantly rely on mid-tech solutions such as WhatsApp, YouTube, and basic tablets, rather than using advanced AI (Salsabila et al., 2022; Arifin & Widyastono, 2020).

This disparity is driven by systemic challenges, including limited facilities, infrastructure constraints, and a lack of crucial teacher training (Nurahma et al., 2025; Habib & Janae, 2024). Therefore, this study aims to analyze the gap between the ideal

potential of AI, its actual implementation in Indonesia, and the challenges that hinder its adoption.

2. METHODOLOGY

This study uses a qualitative approach with the Systematic Literature Review (SLR) method to critically analyze the potential, implementation, and challenges of applying AI to children with special needs. According to Guillaume (2019), a Systematic Literature Review is a method for synthesizing scientific evidence to answer specific research questions transparently, while attempting to include all published evidence on the topic and evaluate the quality of that evidence.

Inclusion criteria were established to ensure relevant study selection, focusing on research articles published between 2016 and 2025 in Indonesian or English that discuss topics related to Artificial Intelligence and Children with Special Needs. The literature search was conducted electronically on Google Scholar using Publish or Perish software.

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were chosen to ensure the clarity, transparency, and quality of the study (Liberati, et al, 2009). The literature selection process can be seen in Figure 1.

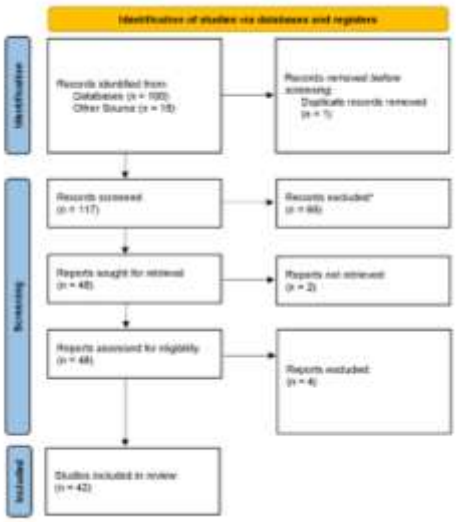

Figure 1. PRISMA Procedure Flow Chart

Based on Table 1, it can be seen that although the data was traced back to 2016, the initial studies found were published in 2019. In addition, the most notable finding from the review is the topicality and urgency of this topic. Of the 42 articles reviewed, the majority of studies were published in the last three years, with a significant increase. This indicates that studies on the use of AI for children with special needs are a rapidly growing field of research and are currently receiving massive academic attention.

3. RESULT AND DISCUSSION

a. The Potential of Artificial Intelligence (AI) for Children with Special Needs

Artificial Intelligence (AI) holds significant potential to support inclusive education. Based on the synthesized literature, AI's primary potential lies in its ability to create learning environments that adapt to student needs, a critical necessity for students with special needs (Arriannor, 2025; Pratama et al., 2025). This capability is underpinned by machine learning and Natural Language Understanding (NLU), which enable systems to read student data in real-time and provide immediate, optimal responses tailored to each student's unique profile (Ayeni et al., 2024). This confirms that AI can deliver deep personalized learning (Tapalova & Zhiyenbayeva, 2022; Ahmed et al., 2025), aligning with the principles of Universal Design for Learning (UDL) to ensure students with disabilities are no longer marginalized (Hopcan et al., 2022; Suwahyo et al., 2022; Afriani et al., 2023).

Concretely, this potential is beginning to materialize as a sensory bridge through various assistive technology innovations. For visually impaired students, for instance, AI can convert visual text into speech using Text-To-Speech (TTS) technology and screen readers such as Non-Visual Desktop Access (NVDA) and Job Access with Speech (JAWS) (Inayah & Prasetyo, 2025; Wijaya et al., 2023; Lutfio et al., 2023). The potential of computer vision is also being expanded to assist in independent object recognition, as seen in devices like "Dif-Able Apps" (Herviani et al., 2022). Similarly, for hearing-impaired students, communication barriers are bridged through Automatic Speech Recognition (ASR) and sign language applications like I-Chat. Meanwhile, for physical disabilities, AI's potential appears in adaptive robotics and eye-tracking technologies, offering tangible solutions for student mobility and independence (Ayeni et al., 2024; Arifin & Widyastono, 2020).

Beyond the physical aspect, AI holds immense potential as a "cognitive prosthesis," a term used by Edyburn (2006) to describe technology that acts as a thinking tool, providing students with disabilities new

Table 1. Selected Articles

Author	Year	Journal Name	Country
Paglialunga, A., & Melogno, S.	2025	Brain Sciences	Italy
Ahmed, et al.	2025	Digital	Bangladesh
Arriannor, W.	2025	Jurnal Al Ulum	Indonesia
Inayah, Y., & Prasetyo, T.	2025	Mudir: Jurnal Manajemen Pendidikan	Indonesia

Author	Year	Journal Name	Country
Muda, R. S. A.	2025	IJNRSM	Indonesia
Nurahma, et al.	2025	JIPSD: Jurnal Inovasi Pendidikan Sekolah Dasar	Indonesia
Elza, P.	2025	Jurnal Inovasi Pendidikan	Indonesia
Pierrés, O., et al.	2025	Education and Information Technologies	Switzerland
Pratama, F. I. P., & Husadani, R.	2025	EDUTECH: Jurnal Inovasi Pendidikan Berbantuan Teknologi	Indonesia
Raza, M. M., Alam, A., & Alam, M. F.	2025	The Academic: International Journal Multidisciplinary Research	India
Chalkiadakis, A, et al.	2024	Education Sciences	Multi-National (UK, US, Sweden, Ghana, Italy, Spain)
Adako, O.P., et al.	2024	Journal of Computational and Cognitive Engineering	Multi-National (UK, Nigeria, Malaysia)
Aliu, T. V.	2024	Systemic Analytics	Developing Countries (Nigeria & Pakistan)
Almufareh et al.	2024	Journal of Disability Research	Saudi Arabia & Pakistan
Ayeni et al.	2024	World Journal of Advanced Research and Reviews	United States
Goldman et al.	2024	Journal of Special Education Technology	United States
Habib, H., & Janae, J.	2024	Bulletin of Engineering Science and Technology (BESTEC)	-
Idhartono, A. R., et al.	2024	Kanigara: Jurnal Pengabdian Kepada Masyarakat	Indonesia

Author	Year	Journal Name	Country
Ismail et al.	2024	Journal of Comprehensive Science	Indonesia
Chemnad, K., & Othman, A.	2024	National Library of Medicine	Mexico
Maulidin	2024	TEACHER: Jurnal Inovasi Karya Ilmiah Guru	Indonesia
Afriani, A., B., et al.	2023	Proceedings of Unimbone 2023	Indonesia
Mawa, H. A., et al.	2023	Jurnal Pendidikan Inklusi Citra Bakti	Indonesia
Lutfio, M. I., et al.	2023	Jurnal Pendidikan	Indonesia
Marino, M.T., et al.	2023	Journal of Special Education Technology	United States
Prayogo, et al.	2023	SOSCIED	Indonesia
Toyokawa, Y., et al.	2023	Springer Open	Japan
Alenizi, M. A. K., et al.	2023	Innoeduca. International Journal of Technology and Educational Innovation	Saudi Arabia
Newman-Griffis, D., et al.	2022	arXiv	-
Habib, H., et al.	2022	Multidisciplinary Science Journal	Brazil
Herviani, V. K., et al.	2022	Jurnal Pendidikan Kebutuhan Khusus	Indonesia
Hopcan, S., et al.	2022	Interactive Learning Environments	Turkey
Suwahyo, B. W., et al.	2022	Edcomtech	Indonesia
Tapalova, O., & Zhiyenbayeva, N.	2022	Electronic Journal of e-Learning	Kazakhstan and Russia
Zdravkova, K., et al.	2022	Frontiers in Artificial Intelligence	Multi-National (Macedonia, Sweden)
Chakraborty, N., et al.	2021	Materials Today: Proceedings	India

Author	Year	Journal Name	Country
Kharbat, F. F., et al.	2021	Emerald Publishing	United Arab Emirates
Lambercy, O., et al.	2021	Frontiers in Robotics and AI	-
Ramadan, Z., et al.	2021	Psychology & Marketing	Lebanon
Arifin, M., & Widyastono, H.	2020	BEST Journal (Biology Education, Sains and Technology)	Indonesia
Bah, Y. M., & Artaria, M. D.	2020	COUNS-EDU: The International Journal of Counseling and Education	Nigeria & Pakistan
Uddin, M., et al.	2019	NPJ Digital Medicine	United Kingdom

opportunities to develop skills (Marino et al., 2023). In cases of neurodiversity, such as Autism SpectrumDisorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD), the technological potential becomes highly specific. AI can facilitate learning environments through neurofeedback tools or time-management gamification (Paglialunga & Melogno, 2025; Aliu, 2024). An analysis by Toyokawa et al. (2023) further indicates that AI can support students at every phase of literacy, utilizing visual behavior analysis that is significantly faster and more precise than conventional methods (Zdravkova et al., 2022).

Within the classroom, AI's potential expands as an intelligent assistant. The presence of Large Language Models (LLMs) like ChatGPT or Intelligent Tutoring Systems (ITS) demonstrates AI's capacity as an interactive virtual tutor (Pierrés et al., 2025; Mogbel et al., 2023; Aliu, 2024). Raza et al. (2025) emphasize that by having AI take over administrative tasks, teachers can refocus on personal interactions and the formulation of accurate Individualized Education Programs (IEP). Although conventional physical media remains relevant (Mawa et al., 2023), digital integration offers a richer new dimension. This potential even extends to the psychosocial realm, where technologies like VR and advanced AI capable of analyzing facial expressions and voice patterns can provide real-time insights into emotional cues, a vital feature for individuals with ASD, while simultaneously reducing stigma through discreet assistance (Adako et al., 2024; Chalkiadakis et al., 2024; Suwahyo et al., 2022).

As a crucial concluding note, although many technologies such as TTS or ASR have been implemented, they do not yet fully represent AI's complete potential. The true transformative power of AI extends beyond these standalone applications; rather, it lies in its future ability to integrate them into a holistic adaptive learning ecosystem.

These findings confirm that AI is not merely a tool, but a transformative force for realizing equitable inclusive education services (Habib et al., 2022).

b. Implementation of Artificial Intelligence (AI) for Children with Special Needs

Indonesia, as the fourth most populous country in the world, cannot be separated from the rapid global trend of Artificial Intelligence (AI). Nationally, Indonesia has recorded a 47% year-on-year increase in AI adoption (Beritasatu, 2023). However, the application of AI and digital technology in Special Needs Education in Indonesia shows a polarized reality. On the one hand, there are those who are undergoing progressive digital transformation. On the other hand, there are many regions experiencing severe infrastructure crises.

On the progressive side, the integration of the digital ecosystem is beginning to show promising results, paving the way for the adoption of AI in the future. One prime example is SLB Negeri 2 Gunungkidul, which is a candidate for Google Reference School. This school has successfully undergone a total digital transformation by integrating the Google Workspace for Education ecosystem into its management and learning processes. Specifically, students with intellectual disabilities and autism are taught to use Chromebooks for learning activities (BKT DIY, 2025). This case indicates that some special needs schools in certain regions have the infrastructure ready to integrate AI.

Conversely, a significant digital divide still persists, especially in Eastern Indonesia. Reports from East Nusa Tenggara (NTT) and Papua highlight a fundamental "blank spot" crisis. In NTT, hundreds of villages do not have adequate telecommunications signals (Yustriani, 2021), let alone the high-speed internet required for AI applications. This situation is exacerbated by geographical challenges and natural disasters such as cyclones. This infrastructure gap is a critical obstacle, as most AI technologies rely on stable connectivity.

However, there are now many studies developing AI for application in Special Education. For example, a study conducted by Inayah & Prasetyo (2025) on the development of AI in the form of a Text-to-Speech (TTS) tool. This tool has a vital feature that can convert written text into speech through digital software and AI assistance. This innovation enables visually impaired students to listen to information smoothly and independently without direct assistance, as well as helping deaf people control electronic devices and communicate. In terms of visuals, this accommodation need is met by Screen Reader devices such as Non-Visual Desktop Access (NVDA) and Job Access with Speech (JAWS), which function to read the screen and even generate Braille sounds by converting graphic text displayed on the computer screen, including emails, websites, program menus, icons, and applications (Lutfio et al., 2023).

In its implementation as a mobility and navigation aid, innovative robot designs have been developed to assist in adaptive ("multi-size") mobility for lower limb disabilities, which are able to adjust to uneven surfaces and stabilize the user's movements, as a form of AI-based physical personalization (Muda, 2025). In addition, advanced technologies such as eye-tracking can also be utilized for students with mobility limitations (Arifin & Widyastono, 2020).

In everyday contexts, AI also provides crucial Functional Support and Independence (Smart Home/Daily Life). AI-based voice assistants such as enable 24/7 functional support and social role support. Through voice commands, people with disabilities can control home devices (such as lights, security systems, and thermostats) and call for help in emergencies, thereby significantly increasing their independence and freedom (Ramadan et al., 2020).

c. Challenges of Utilizing Artificial Intelligence (AI) for Children with Special Needs

The use of AI technology in the context of inclusive education and support for people with disabilities offers positive potential, but on the other hand presents a variety of complex challenges, from technical, ethical, to social aspects. One of the most dominant challenges identified is algorithmic bias. This arises because AI systems are trained using publicly available datasets from the internet, which are not representative of user diversity, including persons with disabilities, so that AI responses may contain implicit biases derived from existing historical and social biases (Goldman, et al. 2024). As a result, in the context of support for persons with disabilities, bias can lead to unequal access to opportunities, services, or resources for individuals with disabilities (Almufareh, et al. 2024). Implicit bias in AI systems can also lead to discrimination against vulnerable groups and hinder the achievement of educational justice. This is in line with the opinion of Ayeni et al. (2024) that algorithmic bias is one of the most detrimental problems in the use of AI technology, especially for people with disabilities.

The aspect of human resource readiness, especially teachers and educators, is another challenge in the use of AI technology. In line with the research by Nurahma et al. (2025), three main problems were found, namely the existence of discrimination in the school environment, minimal supporting facilities, and limited training and readiness of teachers. These findings highlight the importance of teacher training so that they can effectively integrate AI into inclusive learning. In addition, the lack of policy support and educational infrastructure is one of the challenges in the use of AI, especially for people with disabilities. Arriannor (2025) emphasizes that without improving teacher competence and policies that support inclusive education, AI technology risks becoming merely a technical innovation without a transformative impact on students.

Challenges in terms of infrastructure and the digital divide, such as limited access to the internet, digital devices, and technological knowledge, are also major obstacles to the use of AI technology for people with disabilities, especially for students from lower-middle-class families. Zdravkova, et al. (2022) argue that the relatively high price of AI-based assistive devices further widens the economic gap between financially capable and incapable groups in society. Thus, it can be said that poorly designed technology can inadvertently reinforce existing discrimination. This confirms that the challenges of inclusive AI use lie not only in technical aspects, but also in socio-economic issues and the readiness of infrastructure and government service support.

4. CONCLUSION

The use of Artificial Intelligence (AI) in inclusive education offers tremendous transformative potential, especially in creating an adaptive and personalized learning ecosystem for children with special needs. Theoretically, AI can function as a "sensory bridge" and "cognitive prosthesis" through advanced technologies that empower student independence.

However, the findings of this research reveal a highly polarized reality of implementation in Indonesia. On the one hand, there are pockets of digital progress that are ready to adopt advanced digital ecosystems. On the other hand, there is a fundamental infrastructure crisis in 3T regions where electricity and basic internet access remain obstacles, creating an extreme digital divide. As a result, the application of technology is still uneven, even though innovations in academic assistance, visual-auditory communication, and physical mobility are beginning to emerge.

This gap is driven by multidimensional challenges, ranging from algorithmic biases that risk exacerbating discrimination to the unpreparedness of teachers' competencies and real physical infrastructure inequalities. Therefore, this study concludes that the integration of AI in special needs education can only be realized if there are systemic interventions that prioritize equal digital access as a key prerequisite. Without improvements to basic infrastructure and massive teacher training, the adoption of AI risks becoming an exclusive innovation that actually widens the gap of educational inequality.

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Unpacking Curriculum Misconceptions: Critical Insights from Oliva and Implications for Differentiated Instruction

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ABSTRACT

Differentiated learning is crucial in Indonesian education emphasizing student diversity, yet implementation is often hindered by misconceptions about curriculum's nature. While studies on differentiation focus largely on technical aspects, conceptual foundations regarding curriculum understanding remain understudied. This article systematically examines national and international literature on curriculum misconceptions and their impact on differentiation barriers. Using narrative literature review methodology, this study synthesizes and categorizes four primary curriculum misconceptions: (1) curriculum viewed as a document, (2) curriculum perceived as static content, (3) curriculum understood as a rigid national product, and (4) curriculum separated from actual learning practices. These categories were derived from patterns across varied sources and substantiated through Oliva's framework, which defines curriculum as a responsive and dynamic plan of learning experiences. Findings affirm that these misconceptions lead to failures in diagnosing students' learning needs and obstruct meaningful differentiation design. The practical implication emphasizes strengthening curriculum literacy based on dynamic paradigms as a foundation for teacher professional development. This article enriches scholarship by systematically mapping curriculum misconception dimensions and asserting correct curriculum understanding as a prerequisite for effective differentiation.

Keywords: *curriculum misconceptions, differentiated learning, Oliva's perspective, curriculum nature, paradigm transformation*

1. INTRODUCTION

Differentiated learning has become a crucial pedagogical paradigm in contemporary education systems, particularly in Indonesia following the implementation of Kurikulum Merdeka in 2022. This principle aligns with the global commitment to inclusive education (UNESCO, 2015), ensuring every student receives responsive learning experiences aligned with their potential. However, despite widespread advocacy, implementation remains challenging. Research across various contexts indicates that teachers often struggle to design learning that is truly responsive to student diversity, with classroom practices remaining predominantly uniform (Marlina, 2019; Suryani et al., 2020).

Most research on barriers to differentiated learning focuses on technical aspects such as class size, time constraints, or lack of resources (Smale-Jacobse et al., 2019). Meanwhile, the more fundamental conceptual dimension—namely teachers' understanding of the curriculum's nature itself—rarely becomes the focus of critical analysis. Yet, understanding curriculum constitutes the epistemological foundation

underlying all processes of planning and implementing learning (Oliva & Gordon, 2013). Reductionist understandings of curriculum—viewing it merely as administrative documents or static lists of subjects—can obscure its true essence and hinder teachers from designing adaptive learning.

To understand the conceptual roots of these barriers, Peter F. Oliva's theoretical perspective offers a comprehensive analytical framework. Oliva and Gordon (2013) define curriculum as "a comprehensive plan for all learning experiences of students designed and directed by the school." This definition emphasizes that curriculum is a systematic, responsive plan, not merely a static document. This perspective aligns with the essence of differentiated learning, which is fundamentally the practical manifestation of a curriculum understood correctly as a dynamic system of learning experiences. If teachers view curriculum as a rigid product, meaningful differentiation becomes conceptually impossible.

To date, few studies systematically map types of curriculum misconceptions and their specific impact on differentiation barriers in the Indonesian context. This research addresses this gap by conducting a systematic narrative literature review to: (1) identify and categorize forms of teachers' misconceptions about curriculum nature; (2) analyze the impact of these misconceptions on differentiation barriers; and (3) formulate a transformation framework based on Oliva's perspective. This study offers a diagnostic insight into current barriers and a prescriptive framework for transforming teacher understanding, which is critical for the successful implementation of Kurikulum Merdeka.

2. METHODOLOGY

This research employs a narrative literature review approach, namely a narrative-interpretive literature review aimed at synthesizing, analyzing, and interpreting findings from various relevant literature sources (Baumeister & Leary, 1997; Green et al., 2006).

3.1. Research Design

This study employs a qualitative narrative-interpretive literature review approach to synthesize and interpret findings from various sources (Baumeister & Leary, 1997). This design enables in-depth exploration of complex conceptual themes and the integration of perspectives from various disciplines relevant to curriculum theory and differentiation.

3.2. Data Sources

Data sources consist of primary and secondary literature selected from international and national databases, including Google Scholar, ERIC, Scopus, and Portal Garuda. The selection focused on peer-reviewed journal articles, textbooks on

curriculum theory, and relevant policy documents published between 2013-2025. Inclusion criteria prioritized literature discussing curriculum concepts, misconceptions, differentiated learning barriers, and teacher practices in the Indonesian or global context.

3.3. Instruments

The primary instrument used was a structured literature extraction form designed to systematically record literature identity, methodological characteristics, main concepts, key findings, and recommendations from each source.

3.4. Data Analysis Techniques

Data analysis was conducted in four stages: (1) thematic coding to identify main themes related to misconceptions and barriers; (2) categorization of themes into specific misconception categories guided by Oliva's framework; (3) narrative synthesis to integrate findings; and (4) formulation of the interpretation and transformation framework. From an initial 287 potential sources, 52 main literature pieces were selected for final analysis after rigorous screening. Analytical validity was ensured through source triangulation and peer debriefing.

3. RESULT AND DISCUSSION

Understanding Curriculum and Differentiated Learning

According to Oliva and Gordon (2013), curriculum is "a plan or program for all the experiences that the learner encounters under the direction of the school." This definition positions curriculum as dynamic, comprehensive, and student-centered. It aligns perfectly with differentiated learning, which demands responsiveness to student diversity. Therefore, differentiation is not an "add-on" technique but an intrinsic feature of a correctly understood curriculum.

Forms of Curriculum Misconceptions and Their Impact on Differentiated Learning

This research identifies four main forms of curriculum misconceptions that hinder differentiation:

1. Curriculum as an Administrative Document

Teachers often view curriculum merely as "administrative tasks" (syllabi, lesson plans) separate from daily teaching. This "decoupling" leads to teaching practices based on habit rather than planned design. Consequently, teachers neglect the in-depth student needs diagnosis required for differentiation because curriculum work is seen as a formality rather than a foundation for responsive planning.

2. Curriculum as Static Content

Curriculum is frequently reduced to a list of topics to be "covered" or transferred. This "coverage" mentality forces teachers to rush through material, leaving no room for flexibility. In this view, differentiation is seen as an obstacle to finishing the syllabus. Oliva's perspective counters this by framing curriculum as "learning experiences" that should be adapted, not just content to be delivered.

3. Curriculum as a Rigid National Product

Teachers often perceive curriculum as a finished "blueprint" from the government that must be implemented uniformly. This passive "implementer" mindset discourages contextualization. Teachers feel they lack the autonomy to adapt learning to their specific students, directly contradicting the core principle of differentiation which requires adaptation to learner needs.

4. Separation of Curriculum and Instruction

Curriculum ("what to teach") and instruction ("how to teach") are often seen as separate domains. This ignores their integral relationship. When separated, differentiation becomes superficial—applied only at the technical level (e.g., using different media) without connecting to broader curriculum goals, rendering it ineffective.

Transformation Framework: The Four Pillars

Based on these findings, this research proposes a transformation framework based on Oliva's perspective, consisting of four interrelated pillars:

Pillar 1: From Administrative Documents to Systematic Plans. Transforming teachers' view of curriculum from a static formality to a "living plan" that is continuously reflected upon and revised based on student responses.

Pillar 2: From Static Content to Dynamic Process. Shifting the paradigm from "covering material" to creating quality learning experiences. Teachers must understand that content is a means to an end, adaptable to student context.

Pillar 3: From Rigid Product to Adaptive Framework. Empowering teachers as professional "curriculum makers" who have the autonomy to contextualize the national framework for their specific students.

Pillar 4: From Separation to Integration. Building the understanding that curriculum and instruction are inseparable. Differentiated instruction is simply the way a responsive curriculum is enacted.

This framework implies that professional development must move beyond technical training to fundamental conceptual transformation.

4. CONCLUSION

This research concludes that misconceptions about curriculum's nature constitute the fundamental conceptual root of differentiated learning implementation barriers in Indonesia. Four main identified misconception forms—namely curriculum as administrative documents, curriculum as static content, curriculum as rigid national product, and separation of curriculum from learning implementation—collectively create layered barriers hindering teachers in designing and implementing learning that is responsive and adaptive to student diversity. These misconception impacts occur at three levels: conceptual level (misunderstanding that differentiation is responsive curriculum manifestation), practical level (absence of needs diagnosis, uniform learning, and superficial differentiation), and system level (structural barriers in policy implementation). These findings affirm that differentiated learning transformation must begin with curriculum understanding transformation based on Oliva's perspective, emphasizing curriculum as systematic, responsive, and dynamic learning experience plans.

This research recommends to educational practitioners (teachers and school principals) to strengthen curriculum literacy through conceptual understanding-based training, formation of teacher practice communities, and empowerment of contextual curriculum making at school level. Teacher practice communities can become venues for teachers to share experiences, reflect on teaching practices, and collectively design solutions for encountered barriers. To policymakers, this research recommends redesign of teacher professional development programs that focus not only on differentiation techniques but also on curriculum paradigm transformation, as well as strengthening teacher autonomy in contextual curriculum development. Policies must provide space for teachers to innovate and experiment in learning, while maintaining accountability for national learning achievement. To researchers, this research recommends further empirical studies to test effectiveness of Oliva-based curriculum understanding transformation programs, as well as action research to implement proposed transformation frameworks in real contexts. Ethnographic research in schools can provide deep understanding of how curriculum misconceptions manifest in concrete practices.

Beyond these immediate recommendations, this research points toward several broader implications for educational reform and teacher professionalism in Indonesia. First, it highlights the need to reconceptualize curriculum literacy as a core dimension of teacher professional competence. Just as literacy in traditional sense (reading and writing) is foundational to all learning, curriculum literacy—understanding curriculum's nature, purposes, and development processes—is foundational to all aspects of teaching. Current teacher competency frameworks in Indonesia, such as those articulated in national standards, tend to emphasize pedagogical skills, content

knowledge, and professional behaviors, but rarely explicitly address curriculum understanding as a distinct competency domain (Suryani et al., 2020). Elevating curriculum literacy to explicit recognition within teacher professional standards would signal its importance and provide institutional support for its development.

Second, this research suggests the need for fundamental transformation in how teacher education programs approach curriculum. Currently, many teacher education programs treat curriculum as a single course or module focused on technical skills (writing learning objectives, developing lesson plans, creating assessment instruments). While these technical skills are important, they provide insufficient foundation for understanding curriculum as responsive system of learning experiences. Teacher education programs need to integrate curriculum perspectives across multiple courses, helping prospective teachers see connections between curriculum theory, subject matter knowledge, pedagogical approaches, assessment practices, and contextual factors. Moreover, teacher education should explicitly address common curriculum misconceptions, helping prospective teachers recognize and critique these misconceptions before they become entrenched in practice.

Third, this research points toward the importance of creating school-based learning communities where teachers can collectively explore curriculum understanding and differentiated learning practice. Research consistently shows that sustainable professional learning occurs through ongoing, job-embedded, collaborative inquiry rather than through isolated workshops or training events (Priestley et al., 2015). Schools that establish regular structures for teachers to jointly study student work, co-design curriculum adaptations, observe each other's teaching, and reflect on curriculum enactment create conditions for transforming both individual understanding and collective practice. Such learning communities also provide social support and professional validation for teachers attempting to implement responsive, differentiated approaches that may differ from prevailing norms.

Fourth, this research highlights the need for coherent alignment between curriculum policies, assessment systems, and teacher evaluation frameworks. Current misalignment—where policies advocate for differentiated, student-centered learning while assessment systems emphasize standardized testing and teacher evaluation focuses on compliance with prescribed procedures—creates contradictory messages that reinforce curriculum misconceptions. Achieving coherent alignment requires careful policy analysis and systematic reform efforts that ensure all elements of the educational system support responsive, adaptive curriculum enactment. This is particularly important in the context of Kurikulum Merdeka implementation, where policy rhetoric strongly emphasizes differentiation and teacher autonomy, but accountability structures may not yet fully support these principles (Kemendikbudristek, 2022).

Finally, this research underscores the value of theory-practice dialogue in educational improvement. Oliva's curriculum theory, developed decades ago in North American context, proves remarkably relevant for understanding and addressing contemporary challenges in Indonesian education. This relevance suggests that engaging seriously with curriculum theory—rather than dismissing it as abstract or impractical—can provide powerful tools for diagnosing problems and designing solutions. However, such engagement should be dialogical rather than unidirectional: Indonesian educators bringing their contextual knowledge and practical wisdom into conversation with international curriculum scholarship, critically examining theoretical concepts' applicability and limitations in local contexts, and contributing to curriculum theory's ongoing development through grounded insights from Indonesian educational practice. Such theory-practice dialogue enriches both scholarship and practice, contributing to globally relevant yet locally grounded knowledge about curriculum and learning.

This research's limitations lie in its literature-based nature, so it does not involve direct empirical data from teachers or schools. Further research with mixed-methods approaches will provide more comprehensive understanding of how curriculum misconceptions manifest in concrete practices and how understanding transformation can be facilitated effectively. Causality studies between curriculum understanding and differentiation effectiveness also need to be conducted to verify this research's propositions. Nevertheless, this research provides significant contribution by systematically mapping curriculum misconception dimensions and asserting the urgency of correct curriculum understanding as main prerequisite for effective, inclusive, and meaningful differentiated learning for all students. This research also contributes to enriching academic discourse about the relationship between curriculum theory and differentiated learning practices in Indonesia.

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The Role of Collaborative Principles in Curriculum Development for Improving Educational Quality at St. Gabriel Foundation Catholic Schools

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ABSTRACT

The principle of collaboration is one of the important principles in curriculum for developing a contextually relevant curriculum that meets student needs. However, in its implementation, it faces various challenges such as as weak coordination and a limited understanding of stakeholder inclusion, especially foundations, parents, students, and the community, resulting in a process dominated by internal school personnel such as the principal, teachers, and school committee. This has an impact on diminishing stakeholders' sense of ownership over the school's educational curriculum. This literature study analyses the role of the collaborative principle in curriculum development through a systematic analysis of articles (2020–2024) from the SINTA, Scopus, Google Scholar databases and theoretical literature and policy documents. The data collected and identified relates to the collaborative principle in curriculum development, factors that support and hinder implementation, and collaboration that affects quality in educational units. The results show that that a deeply understood collaborative principle is a vital mechanism for improving educational quality at multiple levels within the St. Gabriel Maumere Foundation. A deep understanding of the collaborative principles discussed in this article is expected to be key for curriculum developers at St. Gabriel Foundation Educational Units in building focused and accountable cooperation with stakeholders, thereby improving overall education quality.

Keywords: *Catholic schools, collaborative principles, curriculum development, educational quality, St. Gabriel Foundation.*

1. INTRODUCTION

Improving the quality of education is a top priority for every educational institution, including Catholic schools under the St. Gabriel Maumere Foundation. In this era of scientific and technological development and 21st-century competency requirements, schools are required to provide a curriculum that is relevant, adaptive and contextual to the needs of students and the dynamics of society. A number of studies show that the development of a quality curriculum must be responsive to social and technological changes (Setiadi, 2023; Al-Salmani, 2022).

The curriculum development process is not only technical and administrative in nature, but is also a social process that requires the participation of various stakeholders. This is confirmed by Rizqi and Abidin (2021), who state that a curriculum will be effective if it is developed through the participation of various educational actors. Thus, a comprehensive and effective curriculum document is born from balanced and dialogical collaboration (Ghavifekr, 2020). In this context, the principle of collaboration

becomes one of the fundamental principles in curriculum development. Collaboration enables schools to gather the perspectives, needs and aspirations of all stakeholders, including educators, school principals, foundations, students, parents and the community. Halili et al. (2021) emphasise that the involvement of multi-level stakeholders increases the relevance and acceptability of the curriculum.

However, the reality in several schools within the St. Gabriel Foundation shows that collaborative practices are not yet optimal. Curriculum development is still dominated by internal school elements, particularly the head teacher and teachers. A similar phenomenon was also found by Nastiti (2021), who identified that private schools often face a lack of participation from foundations and parents in the curriculum planning process. The lack of involvement of other stakeholders results in a curriculum that does not reflect the real needs of the school community and a low sense of ownership of the curriculum implementation, as also noted by Susanto (2023).

The challenges that arise include weak coordination, limited understanding of the role of collaboration, irregular communication mechanisms, and the absence of a systematic and sustainable collaborative model. These obstacles are in line with the findings of Yuliani (2020) and Fathurrohman (2022), who mentioned that the implementation of collaborative principles is often hampered by miscommunication, unbalanced roles, and a top-down culture. This situation has the potential to reduce the overall quality of education, because a good curriculum can only be developed through a participatory, inclusive and accountable process (Hikmah, 2023).

Theoretically, the collaborative principle in curriculum development emphasises the active involvement of all stakeholders in education. The collaborative approach encompasses a process of dialogue, negotiation and joint decision-making to develop curriculum documents that are appropriate to the context and needs of the school. This view is in line with modern curriculum development theory, which positions schools as synergistic learning communities (Morrison, 2024).

From an educational management perspective, collaboration is one of the factors that contributes significantly to improving the quality of education. Li and Chen (2021) assert that collaborative leadership can strengthen commitment to curriculum implementation and encourage learning innovation. Meanwhile, an OECD study (2022) shows that partnerships between schools and parents are important predictors of the quality of the learning process.

In the context of Catholic schools, the principle of collaboration is in line with the Catholic educational vision that emphasises community participation, respect for human dignity and cooperation for the common good (Bonum Comune/Common good). Kurian (2021) and Boeve (2023) emphasise that modern Catholic education can only thrive in strong community relationships through dialogue between educators, foundations, families and society. In Catholic schools under religious orders, including SSpS,

collaboration with the foundation is essential to maintain consistency in educational values and spirituality (FSPSS Education Study, 2022).

However, a number of literature (2020-2024) identifies common obstacles in the implementation of collaboration, such as differences in perception between parties (Alverz, 2021), imbalance of roles (Hapsari, 2022) and weak communication and coordination capacity between institutions (Florensia, 2023). Therefore, a systematic review is needed to understand how the principles of collaboration can be effectively applied in curriculum development at both the foundation and educational unit levels.

This analytical approach was adopted in this study to provide strategic recommendations for the St. Gabriel Maumere Foundation.

2. METHODOLOGY

This study utilised a descriptive quantitative approach with a literature review method. Data collection involved various information and references, including journal articles and several other teaching materials (Rijal Fadli, 2021). Data was collected systematically through databases from Sinta, Google Scholar, and Scopus. The search strategy was carried out using specific keywords: collaborative principles, curriculum development, and education quality. From the search results, 24 journal articles and 5 relevant reference books were selected based on the inclusion criteria, namely scientific works published between 2020 and 2024. The collected data were analysed using content analysis and thematic analysis techniques. The analysis stages included 1. Identification and categorisation: data collected based on main categories: definition of collaborative principles, supporting factors, and implementation barriers. 2. Synthesis of findings: linking modern collaboration theory with specific Catholic school values such as spirituality and bonum commune (common good). 3. Contextual analysis: the results of the literature synthesis were used to formulate recommendations for accountable and targeted curriculum development strategies for educational units under the auspices of the St. Gabriel Foundation. Based on the results of brief interviews with the heads of educational units under St. Gabriel, the collaborative principle was not being implemented. The development of educational units is dominated solely by internal units. Therefore, this paper aims to show that the principle of collaboration is an important principle whose meaning needs to be explored and which can be used as a means of improving the quality of multilevel education at the St. Gabriel Maumere Foundation. A deep understanding of the collaborative principle examined in this article is expected to be the key for curriculum developers in the Educational Unit at the St. Gabriel Foundation to build focused and accountable cooperation with stakeholders. In other words, the quality of education will improve if the collaborative principle is developed in curriculum development in the Educational Unit at the St. Gabriel Foundation.

3. RESULT AND DISCUSSION

3.1. Collaborative Principle

The collaborative principle is understood as the principle of cooperation between various parties in the entire process of curriculum planning, development and evaluation. Print (1993) emphasises that curriculum development must involve various stakeholders, including teachers, school principals, committees, foundations and the community, so that the curriculum is more relevant and can be implemented effectively. According to Ornstein and Hunkins (2018), the collaborative principle is defined as a process of joint curriculum decision-making rather than top-down decision-making. This means that a good curriculum is born from a dialogical and collaborative process between decision-makers, especially between teachers as the main implementers and school management. According to Fullan (2007), the collaborative principle is understood as collective cooperation in managing educational change, including curriculum change. This means that curriculum change will be successful if there is professional collaboration between teachers, head teachers and external parties. Haile, T. M and Mekonnen, E. A (2024) define the collaborative principle as the active involvement of stakeholders ini curriculum implementation anda that this involvement has a significant impact on the effectiveness of implementation.

The collaborative principle emphasises the involvement of multi-level stakeholders at every stage of curriculum development. Halili et al. (2021) assert that systematic stakeholder involvement can increase the relevance, acceptability and sustainability of the curriculum. Curricula that are not developed participatively tend to be unsuited to the real needs of learners and the social context of schools. An analysis of academic literature (2020-2024) in this study shows that the collaborative principle is not merely a technical instrument, but rather an 'educational social contract' that guarantees curriculum accountability. Based on data synthesis, there are three unique contributions that highlight the urgency of this study:

1. Transformation of the teacher's role (from implementer to architect): This analysis found that effective collaboration changes the position of teachers from mere implementers of technical curricula to architects of curricula that are responsive to changing times. Without this principle, teachers lose their professional autonomy, which has an impact on the low quality of learning in the classroom.
2. Multilevel synergy as risk mitigation: The unique contribution of this research lies in identifying that multilevel collaboration (Foundation – School – Community) functions as a mitigation system against a rigid curriculum. Through dialogue between parties, schools are able to dynamically revise the curriculum according to emergency situations or the urgent needs of students without having to wait for instructions from the centre.

3. Spiritual-collaborative dimension (unique to the St. Gabriel Foundation): Unlike general literature, this study found that for schools under the auspices of the St. Gabriel Foundation, the principle of collaboration is a manifestation of the value of bonum commune (common good). This finding makes a unique contribution in that collaboration in the context of Catholic schools has a spiritual dimension that strengthens the character of students, rather than merely pursuing administrative academic standards.

Thus, academic literature emphasises that the principle of collaboration is an essential component in producing an adaptive, contextual and quality-oriented curriculum. Therefore, it can be concluded that the collaborative principle is very important in curriculum development. The collaborative principle is defined as cooperation between various parties in planning, applying and evaluating the curriculum in each educational unit, including revising the curriculum in accordance with the situation or conditions and needs of the students.

3.2. Collaboration as a core principle in curriculum development

Social, technological and 21st century competency changes demand a curriculum that is more flexible, adaptive and relevant to the needs of students. The modern curriculum is no longer content-oriented, but must be able to develop critical thinking, creativity, collaboration and digital literacy competencies (Triling and Fadel, 2020). Setiadi's (2023) research confirms that the development of a technology-responsive curriculum has a significant contribution to improving the quality of learning in schools. Similar findings were presented by Al-Salmani (2022), who stated that schools that carry out curriculum reforms based on community needs and global developments tend to have better academic performance. Contemporary literature views curriculum development not merely as a technical activity, but as a social-collaborative process. Rizqi and Abidin (2021), in a grounded research-based study, state that an effective curriculum must be developed through dialogue and participation of various stakeholders, including teachers, school principals, foundation managers, parents, and the community. This is reinforced by Ghavifekr (2020), who found that collaboration between parties in curriculum development increases a sense of ownership and facilitates the implementation of curriculum policies in schools. In the Indonesian context, community involvement in curriculum development is a regulatory mandate through the School-Based Management (SBM) policy, which has been confirmed by various studies that stakeholder participation strengthens the effectiveness of curriculum implementation (Widyastono, 2021).

Thus, collaboration is a prerequisite for the designed curriculum to be able to respond to the demands of the 21st century in a relevant and contextual manner or to meet the needs of the community or students. Curriculum development is a social

process, not merely a technical one. An effective curriculum must be developed through dialogue between stakeholders, including teachers, school principals, foundations, parents and the community. Curriculum changes based on community needs can improve the quality of learning and academic achievement. In Indonesia, this approach is in line with the School-Based Management policy, which requires community participation in curriculum formulation.

In Nastiti's (2021) research, it was found that private schools still face challenges in the form of suboptimal involvement from foundations and parents. The imbalance of roles between teachers, principals and other stakeholders is an obstacle to producing an inclusive curriculum. Susanto's (2023) study shows that a lack of collaboration often results in low. From a Catholic education perspective, collaboration is understood as an integral part of spirituality and educational vision. Kurian (2021) emphasises that modern Catholic schools can only grow in mutually supportive, dialogical, and cooperative community relationships for the sake of bonum commune (the common good). Boeve (2023) states that Catholic education in the 21st century requires the active involvement of families, communities, and church institutions in order to maintain the relevance of faith, moral, and humanitarian values. The FSPSS Education study (2022) highlights that in Catholic schools managed by religious orders, including the SSpS, a collaborative relationship between the school and the foundation is the foundation for ensuring spirituality, character and education.

Contemporary literature from 2020 to 2024 consistently shifts the paradigm of curriculum development from merely a 'technical document' to a 'social-collaborative process.' However, an in-depth analysis of this point reveals several crucial findings that go beyond mere school management theory:

1. Synthesis of the relevance of convergence between the demands of 21st-century skills according to Trilling and Fadel (2020) and school-based management (SBM) policies in Indonesia. The contribution that emerges here is that collaboration is no longer merely a managerial option, but rather an existential necessity. While Setiadi (2023) and Al-Salmani (2022) emphasise technology and academic performance, this analysis expands on this by arguing that for schools under the St. Gabriel Foundation, collaboration is a tool for contextualising the curriculum. In other words, collaboration is how schools translate national standards into the real needs of the Maumere community.
2. Sense of ownership as a catalyst for implementation. Comparing Ghavifekr's (2020) findings on ownership with the challenges portrayed by Nastiti (2021), this study identifies that the main obstacle in private schools is often not the curriculum design, but organisational psychology. The unique contribution of this discussion highlights that when the St. Gabriel Foundation involves parents and the community not as administrative complements, but as dialogical partners,

resistance to curriculum change will decrease dramatically. This positions collaboration as a risk mitigation strategy against the failure of new curriculum policy implementation.

3. Differentiation of collaboration in Catholic educational spirituality. Unlike general studies that focus on the technical efficiency of findings in the context of the St. Gabriel Foundation's Educational Units, general literature views collaboration as a means of system efficiency. At the St. Gabriel Foundation's educational units, collaboration is based on the foundation of communal spirituality.
    - Comparison: While Boeve (2023) emphasises the relevance of faith values, this analysis finds that in SSpS schools (St. Gabriel Foundation), the collaborative relationship between schools and foundations is a form of 'pastoral care'.
    - Unique contribution: the contribution here is not merely a division of tasks, but the realisation of bonum commune (common good). This finding confirms that the success of the curriculum at the St. Gabriel Foundation is not only measured by academic scores (as in Al-Salmani's study), but also by the extent to which faith and moral values are reflected in the synergy between stakeholders.

Based on the above comparison, this analysis concludes that for the St. Gabriel Maumere Foundation, strengthening collaborative practices must go beyond formal mechanisms (meetings/SOP). There must be a transition from administrative collaboration to transformative collaboration, where parents, foundations and the community are involved in defining the quality that the school wants to achieve.

3.3. Barriers to Collaboration in Curriculum Development

Although collaboration is theoretically regarded as a prerequisite for data quality, the literature indicates a wide gap in its implementation. Analysis of these obstacles has yielded the following critical findings:

1. Cognitive conflict and fragmentation of expectations

Alvazer (2021) found that conflicts in perception between school administrators, teachers and parents were a major challenge in curriculum planning. Comparing Alvares' findings with the context of the St. Gabriel Foundation, the first obstacle was not merely technical but rather cognitive. The difference in perception between administrators (who often focus on efficiency) and teachers (who often focus on workload) creates a 'psychological wall'. This study found that if these differences in perception are not bridged through initial dialogue, collaboration will only become an administrative formality without any deeper meaning (pseudo-collaboration). The unique contribution of this point is the need to align the Catholic spiritual vision as a meeting point to unite these differences in expectations.

2. Top-down structural hegemony and the crisis of autonomy.

Haspari (2022) explains that the top-down curriculum planning model limits the participation of teachers and parents. According to him, this imbalance of roles shows that the top-down model is still a chronic 'disease' in education management. This analysis emphasises that the limited space for participation for parents, foundations and the community is not caused by their reluctance, but by the school's bureaucratic structure, which tends to be closed. At St. Gabriel Foundation, the unique contribution of this finding is that the transition to a collaborative curriculum requires humility on the part of school leaders to share authority with other stakeholders.

3. Communication Malfunction: between technology and formal mechanisms.

Florensia (2023) highlights the lack of clarity in inter-institutional communication mechanisms as the cause of weak implementation of collaborative curriculum policies. However, the analysis in this article goes beyond these findings by highlighting that in the digital age, communication barriers are no longer a matter of a lack of tools (such as mobile phones or WhatsApp), but rather a lack of formal communication protocols. The author's analysis found that many institutions consider informal communication to be sufficient without formal mechanisms, resulting in the distortion of curriculum information. This finding highlights that the effectiveness of collaboration at the St. Gabriel Foundation is highly dependent on the formalisation of communication flows so that every curriculum decision can be accounted for (accountable).

4. The Urgency of Standardisation through SOPs (Institutional needs)

Many schools do not yet have clear SOPs or collaboration guidelines for curriculum development (Yuliani, 2020). In line with Yuliani's observation regarding the absence of a systematic model, this study found that without SOPs (Standard Operating Procedures), collaboration will always be incidental (occurring only when there is a project or a change in the national curriculum). The collaboration proposed in this discussion is the need for a 'St. Gabriel Foundation collaboration model' as a technical guideline that integrates national academic standards with the distinctive values of the Foundation. This will transform the obstacle of 'no model' into an opportunity to create a strong and unique curriculum identity.

Overall, analysis of the various obstacles above shows that the constraints faced by schools in the St. Gabriel Foundation are a reflection of systemic challenges in private education in Indonesia. However, by identifying that these obstacles are rooted in communication, roles and procedures, the Foundation has the opportunity to carry out targeted interventions. This article's unique contribution emphasises that the solution to these obstacles is not simply a matter of increasing the budget, but rather of changing the organisational culture to be more inclusive and collaborative.

The author has created a table to make it easier for readers to understand the comparison between common obstacles in the literature and the empirical conditions at the St. Gabriel Foundation.

Table 1. Comparison Between Common Obstacles and The Empirical Conditions

Literature Review (2020–2024)	Empirical Conditions of the St. Gabriel Foundation	Synthesis Analysis
Perception Conflict: Differences in expectations between schools and parents (Alvarez, 2021).	The dominance of internal elements (principals and teachers) in curriculum development.	There is a disregard for external perspectives, which risks reducing stakeholders' sense of ownership.
Role Inequality: A top-down model that limits participation (Hapsari, 2022).	Lack of systematic active involvement of the Foundation in technical curriculum development.	The collaboration model is still coordinative in nature, not yet reaching the stage of substantive-professional collaboration.
Communication Weaknesses: Lack of clear SOPs or collaboration guidelines (Yuliani, 2020; Florensia, 2023)	The absence of a systematic and sustainable collaborative model.	The absence of formal guidelines meant that collaboration only occurred incidentally.

3.4 Factors Supporting the Implementation of Collaboration in Curriculum Development

From an educational management perspective, collaboration is seen as one of the factors that contributes significantly to improving the quality of education. According to Li and Chen (2021), collaborative leadership strengthens teachers' commitment to curriculum implementation, enhances learning innovation, and encourages a collective work culture. The unique contribution of this discussion is the affirmation that St. Gabriel Foundation's participatory leadership must be able to transcend traditional hierarchies. When school leaders open up space for dialogue, this not only increases teachers' technical commitment, but also creates psychological security for teachers to experiment with more creative curriculum content. This changes the face of leadership from instructor to facilitator of collective growth.

Meanwhile, the OECD report (2022) and the study by Erfiana et al. highlight the importance of partnerships with parents, showing that school partnerships with parents, among others, are strong predictors of the quality of the learning process, the effectiveness of curriculum interventions, and student academic success. Collaboratively developed curricula are easier to implement consistently and have a positive impact on school culture and learning outcomes. Furthermore, in the study ‘School strategies in building collaborative partnerships with stakeholders’ by Erfiana, Fradito and Yetri, it was found that the use of parenting programmes, two-way communication (e.g. via WhatsApp) and skills training are important for creating

partnerships with parents. This analysis provides a new perspective that the use of digital platforms (such as WhatsApp) and parenting programmes or parent classes are not merely a means of information but a tool for curriculum democratisation. The contribution of this research unit emphasises that for the St. Gabriel Foundation, parental involvement helps ensure that the curriculum not only pursues academic targets but is also in line with character education at home. This makes the curriculum a 'bridge' that connects family values with school education standards.

Based on research by Rohid Refaldo Syah Putra, it is evident that the transformation of school management towards a collaborative model fosters a culture of organisational participation, collaborative leadership, open communication, and continuous training and evaluation. This discussion reinforces the argument that the formation of **a multilevel curriculum team** (comprising elements from the Foundation and Education Unit) is the most crucial supporting factor. Its unique contribution lies in the idea of a **'Continuous Evaluation Cycle**.' With a formal curriculum revision team, revisions no longer have to wait for the end of the school year but are carried out dynamically based on field data. This gives the St. Gabriel Foundation the flexibility to remain responsive to local challenges in the NTT region.

Although the literature mentions digital platforms in general, this analysis points to the unique contribution of technology as **'organisational memory**'. The use of digital platforms in the collaborative curriculum development of the St. Gabriel Foundation to document every dialogue process ensures the continuity of knowledge, so that even if there is a change in leadership or teachers, the 'spirit' of collaboration in the curriculum is not lost.

Overall, these supporting factors are interlocked. Participatory leadership provides space, collaborative teams provide structure, and communication platforms provide the means. This article's unique contribution concludes that for the St. Gabriel Foundation, these factors must be integrated into **a formal participatory strategy**. Thus, collaboration is no longer considered an additional burden, but rather a daily working mechanism that automatically improves quality and relevance to education on an ongoing basis.

4. CONCLUSION

Based on the above description, it can be concluded that the principle of collaboration is crucial in curriculum development because the involvement of various stakeholders can produce a curriculum that is more relevant, contextual and adaptive to local needs and the needs of students. The systematic involvement of stakeholders has a positive impact on curriculum management and school effectiveness. Challenges in implementing collaboration include differences in perceptions and expectations between parties, imbalance of roles, weak communication and coordination, and the

absence of a systematic collaborative model. However, there are also factors that support the implementation of collaboration, including leadership that opens space for dialogue and participation, building school partnerships with parents, the existence of an internal collaborative team between teachers and management, the use of parenting programmes and two-way communication platforms, and skills training. In the context of St. Gabriel Foundation Catholic School, strengthening the principles of collaboration has great potential to integrate Catholic values into the curriculum as a whole in order to improve the quality of education, not only in terms of academics, but also in terms of the character and spirituality of students.

Schools should continue to strengthen collaboration by developing participatory and transparent leadership models and opening up dialogue between teachers, principals, foundations, parents, communities and students. Collaborative leadership training should be provided to ensure that all leaders are able to manage the curriculum planning process in a demonstrative and inclusive manner. Effective formal and informal communication mechanisms are needed, such as regular meetings, discussion forums and digital communication groups. Collaboration between schools, parents and the community can be strengthened through programme-based cooperation, such as parent classes, community service activities and family visits. It is also necessary to form collaborative curriculum development teams in schools and foundations and to conduct regular collaborative evaluations. The evaluation process involves all stakeholders through joint reflection, surveys and discussion forums. Collaborative evaluation enables comprehensive and continuous curriculum improvement.

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Teachers' Data Literacy for Curriculum: A Comparative Study in Four Developing Countries

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ABSTRACT

This comparative study examined how national education policies translated teacher data literacy into curriculum improvement across four developing countries: Indonesia, Vietnam, Kenya, and Colombia. Using a directed document review, the study analyzed internationally validated policy reports from UNESCO, the World Bank, and the OECD to explore the alignment between policy ambition and classroom-level practice. The analysis was structured around three key dimensions: technological infrastructure readiness, continuity of professional development, and pedagogical use of assessment data. The findings indicated that while all four countries had expanded access to educational data, teachers' capacity to transform data into meaningful instructional action remained uneven. Vietnam demonstrated strong professional integration through collaborative practices, Kenya excelled in community-based and coaching-oriented interventions, while Indonesia and Colombia were undergoing critical transitions that required greater investment in human capital. Across cases, constraints were driven more by systemic and institutional factors than by individual teacher willingness or competence. The study concluded that effective teacher data literacy depended less on data availability and more on sustained professional support, contextual interpretation, and coherent policy frameworks. By synthesizing diverse national approaches, this study offered policy-relevant insights for strengthening teacher capacity and bridging the persistent gap between macro-level data systems and micro-level curriculum enactment

Keywords: *comparative education, curriculum improvement, data-driven decision making, developing countries, teacher data literacy*

1. INTRODUCTION

Teacher data literacy refers to the ability to access, analyze, interpret, and use educational data to make effective, evidence-based instructional decisions (Mandinach & Gummer, 2016; Lee et al., 2024). This competency is not merely technical; it includes the ability to leverage information for curriculum reform, which is increasingly critical as educational data becomes more available through systems ranging from national assessments to digital learning platforms. In the digital and globalized era, these skills are essential; however, teacher data literacy in developing countries remains a significant challenge requiring special attention (OECD, 2024a; UNESCO, 2023).

Data literacy for teachers is often mistakenly equated solely with the technical ability to navigate digital dashboards or calculate statistical means. Mandinach and Gummer (2016) emphasize that data literacy is a complex construct involving the transformation of information into actionable instructional knowledge. In developing

contexts, this definition must be expanded to include *contextual data literacy*, referring to the ability to interpret data within resource-constrained environments where longitudinal data may be fragmented (Glewwe, 2005). The shift from *assessment of learning* (summative) to *assessment for learning* (formative) requires not only analytical skills but also pedagogical content knowledge to adjust curriculum delivery based on real-time evidence.

The global education landscape is undergoing a transformation driven by the "Data Revolution." International organizations such as UNESCO and the OECD promote Data-Driven Decision Making (DDDM) as a mechanism to advance educational equity (UNESCO Institute for Statistics, 2023). DDDM assumes that systematic data collection should inform all levels of the education system, from ministry-level curriculum design to classroom-level differentiation. However, studies in the Global South indicate a largely compliance-oriented adoption of DDDM, in which data are used primarily for administrative reporting rather than instructional improvement (World Bank, 2019b). This study addresses this tension by examining how four developing countries negotiate the gap between administrative accountability and pedagogical utility.

Despite growing global attention to data-driven decision making, research on teacher data literacy in developing countries remains fragmented and largely single-country in scope. Prior studies have examined technical competencies, professional development initiatives, or the effectiveness of specific digital tools (Mandinach & Gummer, 2016; Ansyari et al., 2022a; Lee et al., 2024). Comparatively fewer studies have analyzed how national data policies are enacted across developing country contexts, particularly in relation to infrastructure readiness, professional learning continuity, and pedagogical integration of assessment data. Consequently, the relationship between macro-level policy design and micro-level instructional practice remains underexplored in cross-national settings. This study addresses this gap through a comparative analysis of Indonesia, Vietnam, Kenya, and Colombia, examining how teacher data literacy is shaped by institutional structures and policy environments.

This comparative study examined how teachers in four developing countries—Indonesia, Vietnam, Kenya, and Colombia—leverage educational data to improve curriculum and instructional practices. The cases were selected to represent distinct trajectories of curriculum development within the Global South. Indonesia serves as the primary analytical reference, reflecting rapid national policy transformation. Vietnam functions as a strategic benchmark due to its strong PISA performance relative to economic capacity. Kenya and Colombia were purposively selected as regional exemplars from Africa and Latin America, respectively, based on their distinctive and resilient approaches to data utilization. By synthesizing these cases, the study generates insights relevant to curriculum development both globally and within the

Indonesian context, highlighting strategic opportunities to strengthen teacher data literacy through policy and institutional design.

2. METHODOLOGY

2.1 Research Design

This study employs a Directed Document Review approach, a form of qualitative policy and document analysis grounded in qualitative content analysis (Hsieh & Shannon, 2005). This method does not aim to generate primary empirical data from participants, nor does it constitute a systematic literature review (SLR) or bibliometric study. Instead, it focuses on the systematic examination of policy documents, international reports, and validated institutional publications to evaluate how existing theoretical frameworks are operationalized across national contexts.

Directed document review begins with an a priori conceptual framework to guide coding and interpretation. In this study, the Teacher Data Literacy Framework proposed by Mandinach and Gummer (2016) serves as the analytical lens, allowing the analysis to assess the alignment between policy intentions and implementation practices. This approach is widely used in comparative education research to examine policy enactment across countries, particularly when the objective is to compare structural conditions, governance mechanisms, and professional capacity development rather than individual perceptions or behaviors (Rusydiyah et al., 2021).

By adopting this method, the study systematically compares how four developing countries—Indonesia, Vietnam, Kenya, and Colombia—design and implement data-related education policies, highlighting convergences, divergences, and contextual adaptations. The method is especially suitable for cross-national analysis where access to primary field data is limited, and where policy coherence and institutional design are the primary units of analysis.

The document corpus was purposively selected based on three criteria: international validation by recognized global institutions, direct relevance to teacher data literacy or curriculum-related policies, and publication within the last ten years to ensure analytical currency. Documents published between 2018 and 2025 that met these criteria resulted in a focused corpus of core international and national policy reports for comparative analysis. To enhance analytical rigor, only documents that provided explicit policy guidance, evaluative findings, or implementation insights were included in the analysis, rather than aiming for exhaustive coverage of all available publications.

2.2 Data Sources and Search Strategy

Data collection was restricted to high-credibility sources published between 2018 and 2025 to ensure relevance to the current educational landscape. The primary

inclusion criteria encompassed official government policy documents related to education data or digital transformation, country-specific reports from international organizations such as the OECD, World Bank, and UNESCO, as well as peer-reviewed empirical studies focusing on teacher practices in the target countries. Specifically, data sources were selected to represent key policy instruments for each nation. For Indonesia, the analysis centered on Rapor Pendidikan documentation, Platform Merdeka Mengajar (PMM) usage reports, and Ministry of Education regulations on Merdeka Belajar. For Vietnam, the focus was placed on the OECD TALIS 2024 Country Notes and national digital competence frameworks. In the African context, Kenya's analysis drew from EdTech Hub reports on the Tusome and PRIEDE projects, while for Colombia, data was derived from World Bank assessments of the Evaluate to Advance strategy and UNESCO reports on Media and Information Literacy.

2.3 Data Analysis Process

The analysis was carried out through three distinct stages. First, a thematic synthesis was conducted to identify recurring patterns, challenges, and best practices in teacher data literacy based on three key indicators: infrastructure readiness, professional development continuity, and pedagogical application. This was followed by a synthesis of empirical findings to evaluate the reported effectiveness of professional development interventions on student learning outcomes by reviewing seminal studies, such as those by Ansyari, Groot, and De Witte (2022a) and Hidayah et al. (2023). This stage moved beyond statistical meta-analysis to a descriptive review of impact. Finally, a comparative analysis was performed to contrast policies, practices, and outcomes across the four countries. This process highlighted converging trends and unique contextual adaptations, leading to the formulation of globally relevant policy recommendations based on the identified cross-national evidence.

3. RESULTS AND DISCUSSION

While the four countries exhibit differing strengths and constraints, the analysis applies a consistent analytical framework across all cases to ensure balanced comparison rather than normative ranking. The collected documents were analyzed through a three-phase process. First, thematic coding identified recurring constructs related to infrastructure, professional development, and classroom data use. Second, pattern matching was employed to align national policies with the Teacher Data Literacy Framework (Mandinach & Gummer, 2016). Finally, a cross-case synthesis revealed converging trends and context-specific challenges, forming the basis for globally relevant policy recommendations.

3.1 Indonesia: Integration of Education Report and Training

Teachers in Indonesia are increasingly adopting data use in learning planning and formative assessment (Ansyari et al., 2022a). This development reflects a strategic shift in national education policy through the Rapor Pendidikan (Education Report) and the One Education Data system (Kemendikbudristek, 2024; World Bank, 2024). These systems integrate national assessment results with school climate indicators, providing principals and schools with concrete diagnostic information on institutional strengths and weaknesses. At the classroom level, data literacy is further operationalized through the Platform Merdeka Mengajar (PMM), a digital ecosystem that functions not only as a repository of instructional resources but also as a mechanism for tracking teachers' professional development trajectories.

The PMM platform encourages a self-directed learning cycle in which teachers analyze students' literacy and numeracy outcomes from the National Assessment (AN), select relevant training modules, and apply pedagogical adjustments in their classrooms (Kemendikbudristek, 2024). This process forms a closed-loop model of data utilization that distinguishes Indonesia from the other countries examined by shifting the locus of instructional improvement from centralized supervision to individual practitioner agency. In practice, this approach is reinforced through the 'Identify, Reflect, and Improve' (IRB) model, which positions the Rapor Pendidikan as a diagnostic instrument rather than a compliance tool (Rusydiyah et al., 2021). Nevertheless, significant challenges persist, particularly uneven access to professional development between urban and rural contexts and wide variation in teachers' ability to translate data insights into concrete instructional actions (World Bank, 2024).

This pattern indicates strong policy alignment in data access and professional scaffolding, yet reveals persistent gaps in teachers' interpretive and pedagogical data-use capacities, underscoring a partial realization of the Teacher Data Literacy framework in classrooms.

3.2 Vietnam: Data-Driven Assessment and TALIS Standards

Vietnam demonstrates a strong commitment to educational quality through its participation in the OECD's TALIS. The 2024 survey indicates that 64% of Vietnamese teachers have used AI in teaching, placing the country fifth among 55 participating systems (OECD, 2024a). At the classroom level, adoption tends to be pragmatic and efficiency-oriented, with teachers frequently using generative AI to support lesson planning. In parallel, professional collaboration appears robust, as 95% of teachers reported that professional learning activities were impactful and 69% engaged in team teaching, creating favorable conditions for evidence-informed instructional improvement (OECD, 2024a).

Despite these positive indicators, significant structural constraints persist. Approximately 71% of teachers reported inadequate infrastructure to support AI integration, while limited time availability restricts meaningful engagement with instructional data (OECD, 2024a). In response, the Ministry of Education and Training has emphasized the need to establish national digital competency standards, particularly to address the absence of clear ethical and pedagogical guidelines for emerging technologies. Local research suggests that although teacher enthusiasm for digital tools is high, insufficient preparation in digital pedagogy remains a major barrier to effective implementation (Pham et al., 2024). Without a coherent regulatory and professional framework, the widespread use of AI risks remaining an efficiency-driven practice rather than a catalyst for sustained curriculum innovation.

This case underscores the limits of assessment-driven reform, as rapid uptake of digital tools outpaces the development of professional standards required to embed data use within everyday instructional decision-making.

3.3 Kenya: Collaborative Communities and Evidence-Based Interventions

Kenya has prioritized approaches placing practitioner voices at the heart of policy-making through partnerships with EdTech Hub. By creating 'Sandboxes' for experimentation, the government fosters an environment where teachers can test data-driven strategies without fear of punitive compliance (EdTech Hub, 2025). Research on the *Dignitas LeadNow* app revealed that participants who received coaching alongside data tools demonstrated improved formative assessment practices (Piper et al., 2023). However, intensive data use still faces barriers like limited analysis skills and fragmented data systems (Jawuor, 2020). Locally grounded research reinforces this, noting that despite abundant assessment data, many teachers lack the specific training to perform in-depth analysis for instructional improvement (Omoso & Odindo, 2019).

Addressing these constraints, the success of the Tusome early literacy program provides a critical case study in "low-tech" data literacy. Unlike the digital-heavy approaches in Colombia or Indonesia, Tusome used simple tablet-based data entry for Curriculum Support Officers (CSOs) who visited schools. The data provided teachers with immediate feedback on instructional pacing and student fluency rates. This "short-loop" feedback mechanism proved that high-end infrastructure is not a prerequisite for effective data use; rather, the timeliness of data and the presence of a human coach to interpret it were decisive factors (Piper et al., 2023).

Kenya’s experience highlights the central role of collaborative professional communities and sustained coaching as mediating mechanisms that enable teachers to translate evidence into practice, even in contexts of limited digital infrastructure.

3.4 Colombia: Digital Dashboards and Curriculum Evaluation

Colombia utilizes digital dashboards such as *Evaluate to Advance*, which integrate lesson planning features with adaptive student learning content (OECD, 2024b). These tools support a pedagogical shift from passive content delivery toward more active, diagnostic forms of instruction. Data from TALIS indicate that Colombia performs strongly in formative assessment practices, with 91.3% of teachers reporting the provision of written feedback to students, reflecting a well-established culture of ongoing evaluation (OECD, 2024b).

Despite these advances, a persistent gap remains between policy ambitions and classroom-level implementation. This gap is particularly evident in urban–rural disparities in technological access and the absence of clearly articulated data literacy regulations guiding instructional data use (Durán-Becerra et al., 2023). To address these challenges, Colombia has piloted the UNESCO Media and Information Literacy (MIL) curriculum within teacher education programs. This initiative extends beyond technical proficiency by emphasizing critical cognitive skills required to interpret and apply complex educational data (Durán-Becerra et al., 2023). Through the integration of MIL in pre-service training, Colombia seeks to cultivate teachers who are not merely users of digital dashboards but reflective analysts of student learning trajectories, thereby strengthening the human capacity necessary to realize the pedagogical potential of digital tools (World Bank, 2019a).

This case illustrates that digital dashboards can expand formative assessment practices, but their instructional impact ultimately depends on the development of teachers' critical data interpretation skills and the presence of coherent regulatory guidance to support equitable curriculum improvement.

4. CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The comparative analysis revealed clear divergences in how teacher data literacy was operationalized across the four countries. Vietnam and Colombia primarily emphasized technology-driven approaches, relying on digital dashboards, standardized assessment systems, and emerging AI tools to support instructional data use. In contrast, Indonesia and Kenya placed greater emphasis on human-centered mechanisms, particularly coaching models, professional learning communities, and practitioner-led interpretation of data. Despite these differences, a converging pattern emerged across all cases: while access to educational data has expanded significantly, teachers' capacity to translate data into sustained curriculum improvement remains uneven. This gap is driven less by data availability than by the adequacy of pedagogical support, professional learning continuity, and institutional alignment. Accordingly, effective teacher data literacy development requires not only robust data systems but

also sustained investment in human capital to bridge the persistent divide between policy ambition and classroom practice.

4.2 Recommendations

Building on the comparative analysis across Indonesia, Vietnam, Kenya, and Colombia, this study underscores that the effectiveness of teacher data literacy initiatives is shaped less by the sophistication of data systems than by the extent to which teachers are supported to interpret and apply data pedagogically. From a theoretical perspective, these findings call for a reconceptualization of teacher data literacy as a contextual and relational competence, situated at the intersection of policy design, professional learning, and classroom practice. Such a reconceptualization helps explain why similar data infrastructures yield divergent instructional outcomes across national contexts.

In practical terms, the study suggests that investments in educational data systems must be accompanied by professional development models that are continuous, collaborative, and closely aligned with teachers' instructional realities. Evidence from the four cases indicates that teachers engage more meaningfully with data when learning opportunities are embedded in practice. This engagement is further strengthened by coaching, peer collaboration, and short feedback cycles. These conditions enable data to function as a tool for reflective practice rather than as an administrative requirement. As a result, the instructional relevance of data is more likely to be sustained.

At the policy level, the findings highlight the need for coherent national frameworks that explicitly define teacher data literacy, including its ethical, pedagogical, and contextual dimensions. Without such clarity, data-driven reforms risk remaining compliance-oriented and unevenly implemented. Greater alignment among curriculum reform, teacher education, and data governance can help bridge the persistent gap between macro-level policy ambitions and micro-level instructional decision-making. Ultimately, strengthening teacher data literacy through integrated policy and practice offers a viable pathway for transforming educational data from a reporting instrument into a lever for sustained curriculum improvement and instructional quality.

4.3 Limitations and Future Research Directions

While this study provides a comparative policy-level analysis across four developing countries, its methodological scope is necessarily bounded. The directed document review draws on secondary institutional sources that may privilege normative policy narratives over lived classroom realities. As a result, the analysis does not capture teachers' experiential perspectives or informal data practices that extend beyond documented frameworks. Nevertheless, this approach is well aligned with the

study's objective of examining structural conditions, governance mechanisms, and policy coherence across national contexts. Future research could extend these findings through empirical designs, including teacher interviews, classroom observations, or mixed-method approaches, to deepen understanding of how data literacy is enacted at the instructional level.

Building on these policy-oriented recommendations, future research could extend this comparative analysis by examining how teachers interpret, negotiate, and enact data use in everyday instructional contexts. In particular, qualitative and longitudinal studies, as well as evaluations of targeted professional learning interventions, would be valuable for capturing how teacher data literacy develops over time. Such inquiry would help clarify the conditions under which data-driven policies translate into sustained curriculum improvement at the classroom level.

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Teacher Readiness for AI Education: A TPACK-Based Study in Basic Schools

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ABSTRACT

This study investigated teacher readiness for integrating artificial intelligence in basic education by applying the TPACK (Technological Pedagogical and Content Knowledge) framework. The research addressed the problem of uneven teacher preparedness in adopting artificial intelligence for instructional and professional practices across primary and secondary schools. A qualitative exploratory design was employed using open-ended survey questions to investigate how teachers demonstrated their content, pedagogical, and technological knowledge, how the intersections of these domains emerged in their classroom planning, and what opportunities and challenges influenced their capacity to achieve integrated readiness. Data were collected from eight teachers across three schooling levels, primary, lower secondary, and upper secondary. The findings showed that teachers generally understood the basic functions of artificial intelligence and used it primarily for lesson exploration and administrative preparation, yet they struggled to connect technological tools with pedagogical design and subject representation. Instances of meaningful integration occurred but remained limited, particularly in schools with constrained infrastructure. The study also revealed that teachers perceived artificial intelligence as beneficial for differentiation, efficiency, and reflective practice, although concerns related to ethical use, accuracy, and student dependency persisted. Overall, the results indicated that teacher readiness was developing but had not reached a fully integrated form. The study concluded that sustained professional development focused on technological, pedagogical, and content integration, along with institutional support, was necessary to foster equitable and meaningful use of artificial intelligence in basic education.

Keywords: *artificial intelligence, basic education, education, teacher readiness, TPACK*

1. INTRODUCTION

The swift momentum of digital transformation has fundamentally altered education systems worldwide, establishing Artificial Intelligence (AI) as a key engine of pedagogical advancement in the 21st century. Rather than functioning solely as a technical instrument, AI has evolved into a transformative force that shapes curriculum development, instructional approaches, assessment methods, and the shifting professional responsibilities of teachers (Meylani, 2024). Within primary and secondary schooling, AI tools, including adaptive learning applications, automated evaluation systems, and personalized content platforms, have shown considerable potential to improve learning equity, instructional efficiency, and student achievement (Zhang & Zhang, 2024). However, international studies indicate ongoing disparities in school infrastructure, teacher digital competence, and ethical preparedness, contributing to inconsistent levels of AI adoption across educational contexts (Estaiteyeh & McQuirter,

2024). Given that teachers act as the primary link between AI innovations and classroom implementation, understanding their readiness is crucial to ensuring that AI's educational benefits are realized in fair, responsible, and pedagogically effective ways within basic education (Ahumada, 2024).

The adoption of AI in basic education offers considerable promise while simultaneously introducing notable challenges. On the positive side, AI has the capacity to facilitate personalized learning trajectories, reduce teachers' administrative burdens, and provide immediate feedback that enhances instructional decision-making (Liu et al., 2024). These technologies can increase teacher productivity and enable more focused attention on student engagement and the development of higher-order cognitive skills (Baule & O'Connell, 2025). Conversely, the effective use of AI is frequently hindered by inadequate digital infrastructure, limited teacher understanding of AI concepts, issues related to data privacy and algorithmic fairness, and pronounced disparities between well-equipped and under-resourced schools (Jantanukul, 2024). Such obstacles are especially evident in contexts with constrained resources, where access to professional development is inconsistent and digital innovation remains fragmented (Wangdi, 2024). As primary and secondary schools play a critical role in fostering students' digital competencies and ethical sensitivity, teachers' readiness to integrate AI becomes a key determinant in ensuring that its educational advantages are realized while mitigating associated risks (Yadav, 2025).

Teacher readiness for AI integration involves more than technical proficiency; it includes teachers' motivation, confidence, and autonomy in using and experimenting with AI tools in varied classroom contexts (Tarisayi, 2024). Studies indicate that intrinsically motivated and self-efficacious teachers tend to adopt AI more effectively, even when institutional support is limited (Shafik, 2024). However, many still rely on informal learning, such as peer collaboration and online communities, due to insufficient formal training and institutional guidance (Ahumada, 2024; Minnillo et al., 2024). This situation often results in uneven and fragmented implementation, underscoring the need for systematic examination of how teachers engage with AI across different support conditions (Kaiser & Kaiser, 2025). In basic education, such readiness is crucial, as teachers serve as digital and ethical role models and ensure that AI is integrated responsibly and equitably (Zhang & Zhang, 2024).

To analyze teacher readiness for AI in a comprehensive manner, this study employs the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006). TPACK explains effective technology integration through the interaction of Content, Pedagogical, and Technological Knowledge, along with their subdomains (TCK, TPK, and PCK) which together illustrate the complex relationship among content, pedagogy, and technology (Harris & Hofer, 2011; Koehler et al., 2013). Recent scholarship suggests that AI integration necessitates extending this framework

to include AI-specific competencies such as AI-TK, AI-TPK, and AI-TCK, reflecting AI's unique capabilities, constraints, and ethical dimensions (Bautista et al., 2024). Models like Intelligent-TPACK further highlight the importance of ethical and reflective practice (Selik, 2023). Consequently, TPACK and its AI-oriented adaptations provide a strong theoretical foundation for evaluating teacher readiness in the rapidly evolving era of AI in education.

Although research on digital transformation in education is expanding, notable gaps persist. Much of the literature still concentrates on general ICT integration rather than treating AI as a distinct domain with specific pedagogical and ethical implications. Existing studies also focus largely on higher education, leaving primary and secondary teachers underexplored despite their key role in building early AI literacy (Holmes & Tuomi, 2022). Moreover, prior work often emphasizes infrastructure over teachers' agency, motivation, and autonomy, especially in contexts with limited institutional support (Alshammary & Alhalafawy, 2023). Empirical studies from resource-constrained basic schools remain particularly limited, even though these settings face unique challenges in capacity, training, and ethical preparedness (Scherer et al., 2023; Zawacki-Richter et al., 2019). These gaps highlight the need to examine how teachers in basic education engage with AI through the TPACK lens and how their readiness is shaped by both enabling factors and systemic barriers.

In response to these gaps, the present study aims to examine teacher readiness for AI education in basic schools by applying the TPACK framework. Specifically, the study seeks to: (1) analyze how teachers demonstrate their Content, Pedagogical, and Technological Knowledge in integrating AI into teaching and professional practice across primary and secondary levels; (2) identify the extent to which the intersections of TPACK (TCK, TPK, and PCK) emerge in teachers' use of AI for lesson design, instructional strategies, and student engagement; and (3) investigate the opportunities and challenges that influence teachers' capacity to achieve integrated TPACK readiness for AI adoption, particularly in resource-constrained school contexts. Through these objectives, the study intends to provide empirical insights that support more coherent, equitable, and sustainable AI integration in basic education.

2. METHODOLOGY

2.1. Research Design

This study employed a qualitative exploratory research design to investigate teacher readiness for AI integration in basic education. An exploratory approach was selected because the use of AI in primary and secondary schools remains an emerging area, requiring flexible inquiry to capture teachers' evolving practices, perceptions, and contextual realities. Positioned within an interpretivist paradigm (Saunders et al., 2016), the study emphasizes understanding subjective meanings constructed by teachers

regarding AI use. This design aligns with Creswell (2014) view that qualitative exploratory studies are appropriate for examining complex and underexplored educational phenomena.

2.2. Participants of the Study

Participants consisted of eight teachers selected through purposive sampling to ensure representation across various levels of basic education. The sample comprised three primary school teachers (SD), two lower secondary teachers (SMP), and three upper secondary teachers (SMA). Purposive sampling was employed to include teachers with direct experience in using AI tools for instruction, consistent with qualitative research that prioritizes depth of insight over sample size breadth (Creswell & Clark, 2018). All participants had a minimum of one year of teaching experience and prior engagement with at least one AI-based educational tool.

2.3. Instruments

Data were collected using an open-ended survey instrument designed to elicit detailed accounts of teachers' experiences with AI in classroom and professional settings. The instrument consisted of three sets of questions aligned with the research objectives: (1) teachers' demonstrations of Content, Pedagogical, and Technological Knowledge in AI integration; (2) manifestations of TCK, TPK, and PCK in instructional design and learning engagement; and (3) perceived opportunities and challenges shaping their readiness for holistic TPACK.

To ensure validity, the survey items were reviewed by two experts in educational technology and qualitative research for clarity, relevance, and alignment with the TPACK framework. Reliability was enhanced through a pilot test with two teachers, leading to minor revisions for wording clarity and conceptual coherence.

2.4. Data Analysis Techniques

Data were analyzed using thematic analysis following Braun & Clarke (2006) six-step framework: familiarization, coding, theme generation, theme review, theme definition, and reporting. This method was selected for its flexibility in identifying patterns across qualitative responses. Coding was conducted manually to maintain close engagement with the data. The emerging themes were organized according to the TPACK framework to ensure that the interpretation accurately reflected teachers' knowledge domains and the intersections relevant to AI integration. Triangulation was conducted through peer debriefing with an educational technology expert to enhance the trustworthiness of the analysis.

3. RESULT AND DISCUSSION

The findings indicate that teacher readiness for integrating AI in basic education varies widely across school levels, particularly in their understanding of Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK). While most teachers demonstrate basic awareness of what AI can do, they still struggle to connect AI meaningfully with the content they teach. This mirrors Scherer et al. (2023) and Meylani (2024), who highlight that readiness for emerging technologies is strongly shaped by teachers' digital competence and professional experience. As one public elementary school teacher explained, *"I know AI can help create questions or summarize material, but when it comes to explaining a science concept in depth with AI, I honestly don't know where to start."* This sentiment illustrates that AI-related CK remains underdeveloped, especially when teachers attempt to use AI to generate richer representations of disciplinary content.

From the perspective of TK, several teachers reported using generative AI to accelerate routine tasks such as lesson planning, material development, and drafting assessments. These practices resonate with Baule & O'Connell (2025) and Minnillo et al. (2024), who argue that AI has the potential to enhance teachers' productivity through automation and personalization. However, teachers' confidence in aligning AI-generated suggestions with their pedagogical approach remains uncertain. As expressed by a private lower secondary school teacher, *"AI is fast, but I'm never fully sure whether the output fits how I usually teach my students."* This concern aligns with Jantanukul (2024) and Shafik (2024), who emphasize that many educators still treat AI as a technical tool rather than a pedagogical catalyst.

In practice, the intersections of TPK, TCK, and PCK within the TPACK framework were not yet fully evident. Although some teachers experimented with chatbots or AI-based activity generators to diversify instructional methods, deeper pedagogical planning was not consistently visible. This reinforces findings by Harris & Hofer (2011) and Koehler et al. (2013), who argue that effective technology integration requires simultaneous understanding of pedagogy, content, and technology. As noted by a public upper secondary school teacher, *"Sometimes I use AI to look for activity ideas, but the suggestions aren't always realistic for my classroom, where students' abilities vary widely."* The inability to contextualize AI recommendations suggests that both TPK and TCK remain fragile, echoing insights from Bautista et al. (2024) and Liu et al. (2024) on the importance of designing AI-enhanced instruction that is pedagogically and contextually grounded.

Even so, the study identified positive examples of AI-supported instructional innovation. A private primary school teacher shared, *"I created an AI-assisted adaptive quiz, and the students became more engaged because the questions adjusted to their level."* This aligns with Alshammary & Alhalafawy (2023), who assert that digital

platforms can improve learning outcomes when appropriately designed and implemented. Nonetheless, such practices were still relatively rare, suggesting that AI-driven TPACK integration remains uneven across schools.

Teachers across levels also recognized significant opportunities offered by AI, including supporting differentiated instruction, increasing efficiency, and promoting more inclusive learning experiences. These affordances are consistent with Holmes & Tuomi (2022), Zhang & Zhang (2024), and Yadav (2025), who highlight AI's potential to provide adaptive support and personalized learning pathways. Some teachers also used AI to support reflective practice. A upper secondary school vocational teacher remarked, *"Sometimes I ask AI whether my teaching method fits my objectives, and it helps me consider other options I might not have thought of."* This practice reflects Ahumada's (2024) emphasis on reflective digital-era pedagogy.

Despite these opportunities, structural challenges strongly affect teachers' readiness. Limited device availability, weak internet connectivity, and inconsistent platform access hinder AI integration, especially in resource-constrained schools. These findings reaffirm Tarisayi (2024) and Wangdi (2024), who point out persistent digital divides in basic education. Another major barrier is the lack of systematic training that integrates both technical and pedagogical dimensions. This aligns with Bautista et al. (2024) and Kaiser & Kaiser (2025), who note that many AI training programs focus on operational skills rather than pedagogical application. Ethical concerns, such as accuracy, student data privacy, and the risk of plagiarism, are also prominent, as noted in Holmes & Tuomi (2022) and Selik (2023). A public lower secondary school teacher expressed, *"I'm worried that if students rely too much on AI, they won't truly learn, or they'll just copy whatever the system generates."*

Overall, the findings suggest that while teachers exhibit emerging readiness in CK, PK, and TK, the integration of these domains into a cohesive TPACK framework remains limited. The interplay of opportunities and constraints underscores the need for systemic interventions (policy support, sustained professional development, and institutional guidance) echoing recommendations by Zawacki-Richter et al. (2019) and Holmes & Tuomi (2022). Strengthening TPACK competence is therefore essential for ensuring equitable and sustainable AI adoption, particularly in schools with limited resources.

4. CONCLUSION

Based on the study's findings, teacher readiness for integrating AI in primary and secondary schools remains layered and has not yet achieved a fully integrated TPACK form, even though teachers have demonstrated relevant foundational CK, PK, and TK. The answers to the research questions reveal that teachers are able to utilize AI primarily for content exploration and lesson preparation; however, their understanding

of how TPK, TCK, and PCK intersect is still limited, particularly when designing learning experiences that pedagogically leverage AI's capabilities. Challenges related to infrastructure, technological literacy, and ethical considerations further hinder the development of integrated TPACK in resource-constrained school environments. Therefore, this study recommends that policymakers and education authorities provide sustained professional development explicitly oriented toward TPACK-AI rather than general technical training. Schools are also encouraged to establish teacher learning communities that support contextual and ethical AI practices, while teachers themselves are advised to continue strengthening pedagogical reflection so that AI use not only increases efficiency but also enriches students' learning experiences. Through these efforts, AI integration in basic education can progress in a more equitable, meaningful, and sustainable manner.

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The Dynamics of Growth Mindset Research in Indonesia: A Bibliometric Analysis

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ABSTRACT

The concept of a growth mindset has become a subject of ongoing research in various countries. This study aims to identify developments, describe trends in *Growth Mindset* research topics and variables, and analyze the shift in methodological focus in *Growth Mindset* research in Indonesia in the last 6 years. The research design used bibliometrics on 100 articles published in Sinta 1-6 accredited journals. Data collection was conducted using documentation studies in the Sinta search engine. Data analysis was conducted using quantitative, descriptive, and bibliometric methods, aided by the VOSViewer application. The results show a consistent increase in GM publications between 2020 and 2025. Methodologically, there has been a shift from simple quantitative dominance (descriptive/correlation) in the early stages to more complex and integrated methods at the contemporary stage (2024–2025), such as *Systematic Literature Reviews*, Bibliometrics, *Mixed Methods, and Research and Development*. The subject of the study has also expanded drastically, no longer limited to students and college students, but includes school counselors, small business employees, nurses, and fishermen. Key findings indicate that GM has a relationship with Academic concepts (Early Stage: 2020–2021) and progresses to Psychological Concepts and Career Applications (Transition Stage: 2022–2023), ultimately leading to Futuristic and Contemporary Variables (Contemporary Stage: 2024–2025). Further research is recommended to test the effectiveness of GM interventions by applying *Mixed-Methods* or *Research and Development* (R&D) research methods to address specific gaps. Researchers also need to associate GM with contemporary issues such as VUCA, digitalization, or *well-being*.

Keywords: *bibliometric analysis; growth mindset; Indonesia; research trends.*

1. INTRODUCTION

Mindset is a crucial belief framework that enables individuals to take action against every opportunity and challenge. The initial concept of mindset is based on the theories of intelligence put forward by Carol Dweck (Dweck, 2006). Individual mindset is categorized into two types: fixed mindset (entity theory) and growth mindset (incremental Theory) (Dweck & Yeager, 2019). Entity Theory is a view in which individuals believe that intelligence is a fixed and unchangeable nature (static), also called Fixed Mindset (fixed mindset). Incremental Theory is a view in which individuals believe that intelligence and abilities can be developed over time through effort, strategy, and learning, or better known as the concept of Growth Mindset (Haimovitz & Dweck, 2017). The concept of mindset remains a research trend that is studied in various countries, as the growth mindset has been proven to have a positive impact on individuals.

A growth mindset has a profound impact on individuals, particularly in academic and self-development fields. Growth mindset can affect improved academic achievement (S. Chen et al., 2023); Influence students' viewpoints on motivation (Aditomo, 2015); foster resilience, engagement, and persistence in students that significantly impact their academic improvement (Xu et al., 2022)**;** Students with an evolving mindset set self-improvement as an achievement goal, use all of their resources, attribute failure to something that is under their control, and work harder when faced with setbacks (Stohlmann, 2022). The practical implications of the evolving mindset, including the ability to motivate oneself and reflect on failure, have prompted researchers to empirically test their impact. Various studies were then carried out, covering the background of the field.

The research background includes the fields of health professional education (Wolcott et al., 2021) and medical education (Richardson et al., 2021). Study *the Growth mindset,* especially in the field of education (Zintz, 2018). The context of the research subject in the scope of education includes *the Growth mindset* for the teacher (Bardach et al., 2024; Rissanen & Kuusisto, 2023), students (Limeri et al., 2020; Sheffler et al., 2023; Tao et al., 2022), high school students (Limeri et al., 2020), junior high school students (Vestad & Bru, 2023), and elementary school students (Muradoglu et al., 2024). Improving the Growth Mindset of students continues to receive attention for individual development, including in Indonesia.

Increasing awareness of the importance of character development and individual academic success encourages research on the growth mindset at various levels of education. The application of this concept in educational institutions, corporate training, and personal development catalyzes enhancing the quality of education and the nation's competitiveness. However, although individual studies on Growth Mindset have begun to emerge, a comprehensive mapping of trends, patterns, and research focuses conducted in Indonesia remains limited.

To fill this gap and provide a solid foundation for future research agendas, this article focuses on a systematic analysis of research on Growth Mindset in Indonesia. Therefore, this study aims to: (1) Present data on the distribution of growth mindset research in Indonesia, (2) Describe the trends of Growth Mindset research topics and variables in Indonesia in the last 6 years; and (3) Analyze the shift in methodology focus in *Growth Mindset* research in Indonesia. Through this careful synthesis and analysis, this article not only presents an existing research map but also provides a clear direction for researchers, practitioners, and policymakers in utilizing and developing the concept of *Growth Mindset* in a more targeted and impactful manner in Indonesia.

2. METHODOLOGY

Research Design and Procedure

The research design used was a bibliometric study. Bibliometrics are used to describe patterns and relationships in research topics, identify current research trends, and provide a roadmap for future research (Xu et al., 2022; Raman et al., 2021). This study was chosen to comprehensively identify, evaluate, and synthesize all relevant literature on research *on Growth Mindset* in Indonesia. Data were processed and analyzed to identify thematic trends, related variables, and specifically the shift in methodological focus that the researcher applied from year to year.

The data collection procedure is carried out through four main stages: (1) Literacy Search: Identification of articles using the keywords *"Growth Mindset"*, *"Indonesia"*, in reputable scientific databases (The researcher focuses on the Sinta-indexed national journal portal); (2) *Screening*: Screening of titles and abstracts to ensure topic relevance and inclusion criteria are met; (3) *Eligibility*: Full reading of the article for final verification of inclusion criteria; and (4) Data Extraction: Retrieval of relevant data from the selected article and inclusion of it in the research results report.

Data Source

The source of data for this research is documentation in the form of scientific articles published in Sinta 1-6 accredited journals. A total of 100 articles were selected based on strict inclusion criteria, namely: (1) The article explicitly contained the title of growth mindset; (2) Publications must be published within the last 10 years to capture the latest trends; (3) The article must focus on the population in Indonesia (students, students, or teachers); (4) the article presents a complete research method; (5) Articles are available on https://sinta.kemdiktisaintek.go.id/ search engine.

Data Analysis

Data analysis was carried out in quantitative, descriptive, and bibliometric analyses. Quantitative descriptive analysis was used to map the frequency of publications per year, the distribution of subjects, and the frequency of articles indexed in 1-6. The process continues with a qualitative analysis of the synthesis applied to classify and interpret the methodology used, identify patterns and shifts in methodological focus over time, and identify theoretical implications and recommendations for future GM research. In addition, bibliometric analysis is also used to see mapping patterns and trend linkages in growth mindset research topics. This analysis process is carried out with the help of the Vos Viewer application version 1.6.20.

3. RESULT AND DISCUSSION

Descriptive Summary of Literature Data

Literature data is presented based on: distribution of publications per year, publications in Sinta-accredited journals, research methods, and distribution of research subjects. Preliminary results are presented with the development of growth mindset research each year in Figure 1.

Figure 1. *Growth Mindset Publication Every Year*

Based on Figure 1, the number of research on growth mindset in Indonesia has increased consistently and substantially during the period from 2020 to 2025. Starting with just 3 publications in 2020, this number doubled to 6 in 2021. The growth was even more explosive in the following years, reaching 16 publications in 2022 and 20 in 2023. This positive trend peaked with 27 publications in 2024 and reached the highest number of 28 publications in 2025. These findings are reinforced by the visualization of the overlays presented in the figure 2.

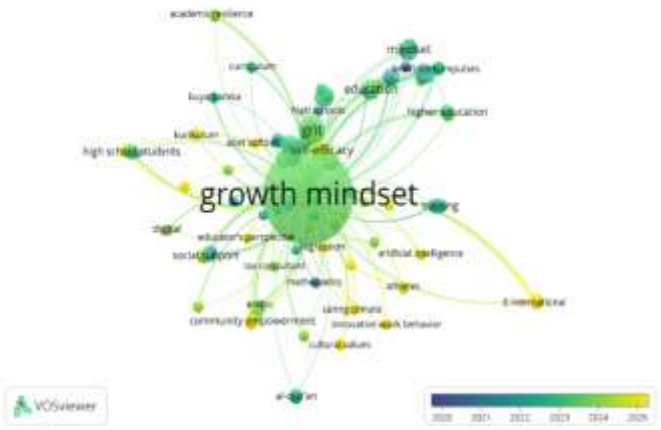

Figure 2. *Overlay Visualization*

This keyword analysis visualization shows that the initial trend of the research (2020–2021) is rooted in the context of formal education, characterized by keywords such as *curriculum* and high *school students*. Research on the "growth mindset" has been the core focus and most extensively researched area in the mid-period, along with

related concepts such as “grit” and “self-efficacy” (around 2022–2023). Over time, research moved away from this core and expanded significantly to newer and more specific domains and methodologies (marked in yellow, 2024–2025). This latest expansion includes applications in the fields of training and sports (for athletes), as well as the use of new technologies and methods such as artificial intelligence and regression, indicating that the *study of growth mindset* is now increasingly penetrating professional, technological, and global/*international* contexts.

Overall, this data indicates a sharp increase in interest and attention to research on the topic of *Growth* Mindset in the last six years. This publication is spread across various Sinta-accredited journals, as presented in Figure 3.

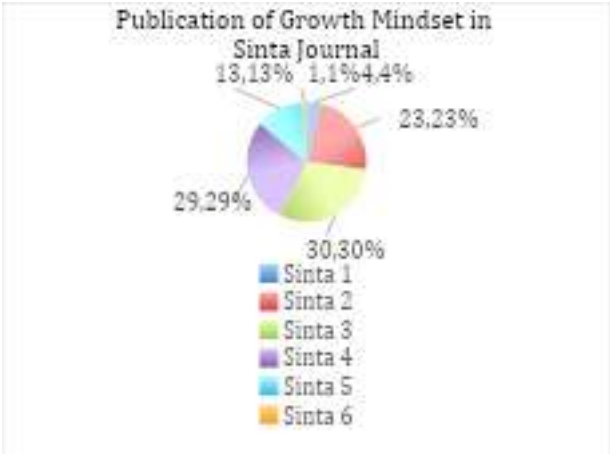

Figure 3. *Distribution of Growth Mindset Publications in Sinta Journal*

According to *the* data in Figure 3, it can be observed that the majority of publications focused on journals with SINTA 3 (29%) and SINTA 4 (30%) accreditations. This means that two-thirds of publications (59%) are in journals with intermediate-level Sinta accreditation. Sinta 2 Journal also has a significant contribution of 23%. On the other hand, the journals with the highest (Sinta 1) and lowest (Sinta 5 and Sinta 6) accreditation ratings have a tiny proportion. Publications in Sinta 1 account for only 1% of the total, while those in Sinta 5 and Sinta 6 comprise 13% and 4%, respectively. This indicates that researchers tend to publish Growth Mindset studies in journals with moderate accreditation in Indonesia. The diversity of these publications is also in line with the diversity of research methods used, presented in Table 1.

Table 1. Types of Research Methods

Research Methods	Sum	Percentage
Correlation	38	38%
Qualitative	15	15%
Literature Study	12	12%
Survey	11	11%
Experiment	11	11%

Research Methods	Sum	Percentage
Structural Equation Model	5	5%
Instrument Validation	4	4%
Mixed Method	2	2%
PTBK	1	1%
RnD	1	1%
	100	**100%**

Based on the data in Table 1, the diversity of research methods used is presented. The dominance of research methods in the form of correlation, with a frequency of 38%, makes it the most frequently used approach to research the relationship between variables. Qualitative Methods and Literature Studies occupy the next position, with 15% and 12%, respectively, indicating the significance of in-depth comprehension-based studies and literature reviews. Interestingly, the Experiment and Survey methods have the same proportion, which is 11%. More specific or complex methods, such as SEM (5%) and Instrument Validation (4%), as well as development and action methods (Mixed Method, PTBK, RnD), which together account for only 4%, indicate that the focus of research tends to be on associative and descriptive studies rather than complex interventions, development, or modeling. The research conducted also encompasses a range of research subjects.

The most frequently researched subject group is college students, followed by a large number of workers and high school students. This highlights the strong research focus on young adult populations in both academic and professional settings. In addition, subjects such as teachers and junior high school students are also a significant population. Other populations, including elementary school students, lecturers, Communities, and COVID Patients, occupy only a much smaller portion. In summary, the majority of studies in this dataset targeted subjects from academic and professional environments.

Variable Trends related to Growth Mindset Research in Indonesia

Growth Mindset research in Indonesia shows a shift in focus from basic correlation studies to applied and contextual studies that are directly related to contemporary education and workplace issues. The development of research variables related to growth mindset research in Indonesia is presented in the table 2.

Table 2. Variable trends related to growth mindset research in Indonesia

Aspects/ Time	Research Focus	Related Topics and Variables
Early Stage (2020–2021)	In the early stages, this is very basic and traditional.	**Academic:**The most frequently researched variables are Academic Achievement Academic Achievement, Grit, and Psychological Concepts (Praise, Motivation, Self-Efficacy).

Aspects/ Time	Research Focus	Related Topics and Variables
Transition Stage (2022–2023)	At this stage, there is an expansion and deepening of the variable, along with a surge in the number of publications.	**Academic**: The Achievement variable is still dominant, but there is a significant focus on more complex variables such as Resilience, Self-Efficacy, Student Engagement, Learning Management System (LMS), and Innovative Behavior **Skills:** problem solving, digital literacy. **Career:** Concepts related to careers (Work Engagement, Career Adaptability) emerged
Contemporary Stage (2024–2025)	The focus of variables has become more diverse and futuristic.	Researchers began to associate *Growth Mindset* with contemporary issues **21st Century Skills:** Readiness to Face VUCA, 21st Century Skills, Creativity **Academic:** Self-regulated learning, Academic Self-efficacy, Student Engagement, **Mental health:** Subjective well-being, Psychological Empowerment, and school well-being, Mental Health, the purpose of life Psychological Safety **Social Personal:** parental support, Continuous Learning Cultures, peer social support, Proactive Personality, **Career:** Career Adaptability, Entrepreneurial growth mindset, Entrepreneurial performance, Technopreneur competence, Entrepreneurial Leadership, Community Empowerment, Job Flourishing, work productivity
Further Research Direction (Novelty)	Contextual focus can be more specific with the dynamics of GM change	Testing GM as a mediation/moderation variable in the context of the Independent Curriculum, or connecting GM to social issues (such as digital literacy, readiness to face VUCA, or well-being).

In the early stages, the variables studied still focused on things that are commonly associated with a growth mindset. It aligns with the still low number of publications, where researchers focus on testing the relationship between *the core of Growth Mindset* and academic outputs, as well as basic personality characteristics. At the transition stage, it shows a shift from simply measuring academic outputs to testing broader psychological mechanisms. The scope of research is beginning to develop in the field of career development. At the contemporary stage, research trends seek to integrate *the Growth Mindset* with today's practical needs and global challenges. This is also supported by the results of a bibliometric analysis, as presented in the network visualization in Figure 4.

Figure 4. *Network Visualization Growth Mindset*

The findings in the VOS viewer presented 50 clusters, each comprising 237 items. This indicates that the data set with the keyword' growth mindset' has a comprehensive and diverse coverage of topics. The first cluster presentation focused on contextual and social applications. The topics that emerged emphasized the implementation of the growth mindset in society, high schools, leadership/entrepreneurship contexts, as well as research related to culture/religion. Items that appear include Arabic, boarding school, community empowerment, entrepreneurial leadership, Islamic studies, mentoring, organizational trust, sustainable tourism, positive discipline, tourism village, and written work.

The second cluster focuses on the theoretical foundations and psychological concepts that relate to the core concepts of the growth mindset, including the origin of Carol Dweck's theory, the psychological basis used (behavioral psychology and cognitive psychology), and its connection to other psychological aspects. Items that appear include academic grit, behavioral psychology, brainstem impulses, Carol Dweck, cognitive, fixed mindset, human behavior, moral values, psychology, self-efficacy, and ethical decision-making.

The next cluster focuses on contextual applications. Items that appear include: early adulthood, creative, career adaptability, intelligence theory, speaking ability, and mindset. The Indonesian context is also represented in this visualization, among others, through cooperation: Al-Qur'an, Buya Hamka, and cultural values. One of the significant areas of development is the connection between *growth mindset*, community empowerment, and entrepreneurial leadership, indicating a shift from the classroom to the social and professional spheres.

Methodological shift in Growth Mindset research in Indonesia

The shift in methodology in Growth Mindset research in Indonesia shows a dynamic evolution, both in terms of research approaches and the scope of the subjects

studied. To provide a comprehensive picture of this transformation, details of developments from 2020 to the projection of further research directions are presented in Table 3.

Table 3. Methodological Shifts in Growth Mindset Research

Time/ Aspects	Research Methods	Research Subject
Early Stage (2020–2021)	Dominant quantitative descriptive or simple correlation.	Elementary school students. High School Students, College Students
Transition Stage (2022–2023)	Correlations, Explanatory with path analysis, Surveys, Structural Equation Model (SEM), Experiments, Case Studies, Qualitative Descriptive, Phenomenology	Junior High School, High School, Vocational School, Students, Athletes, Company Employees, Educators/Teachers
Contemporary Stage (2024–2025)	Correlations, Systematic Literature Review, Bibliometric, Mixed Method, Research and Development, Studi Kasus, Structural Equation Model (SEM),	Students: Elementary, Junior High, High School/MA, Vocational School; Student, school counselor, Teacher, Lecturer, Corporate employee, small business employee, Nurse, softball athlete, fisherman
Further Research Direction (Novelty)	Focus on Mixed Method research (quantitative and qualitative combined) or Research and Development (R&D) to produce new products/models. The use of a Systematic Literature Review or Bibliometric to map and fill research *gaps* that are very specific and untouched	Expanding the subject to more specific groups has not been widely researched in an educational/psychological/social context. Connecting research variables with current issues (e.g., digitalization, *well-being*, mental resilience, data literacy, *sustainability*) that are relevant to the expanded research subject.

Table 3 reflects a significant shift in methodology and subject diversification in *the Growth Mindset study* in Indonesia between 2020 and 2025, signaling an evolution from a fundamental approach to a sophisticated and multidimensional approach. In the initial phase (2020-2021), the research was predominantly quantitative, focusing on general subjects in formal educational environments, including elementary to secondary school students and college students. Rapid changes were observed in the transition stage (2022-2023), where methods began to be enriched with path analysis, *Structural Equation Modeling* (SEM), experiments, and qualitative studies, such as Phenomenology, in line with the expansion of the subject to workers/employees, educators, and athletes. The peak of this shift is reached in the contemporary stage (2024-2025), where methods become highly integrated and systematic, including

Systematic Literature Review, Bibliometrics, Mixed Method, to *Research and Development* (R&D), while research subjects extend drastically to a wide range of specific professions (such as school counsellors and nurses) and the informal sector (such as small business employees and fishermen). Therefore, the future direction of research is strongly recommended to utilize Mixed Method and R&D to produce new products, use systematic reviews to fill precise research gaps, and connect research variables with contemporary issues such as *well-being* or digitalization.

DISCUSSION

This literature review yields crucial findings that are highly relevant and have strong support in the context of the research *on Growth Mindset* (GM) in Indonesia. There has been a significant increase from year to year, starting from 3 publications to 28 publications in 2025. This shows a keen interest and attention to the topic of growth mindset in the academic community. The topic of Growth mindset is the core of the study, but the research develops from basic academic concepts (2020-2021) to psychological concepts and career applications (2022-2023) to futuristic and contemporary variables (2024-2025). The initial contribution of the growth mindset is very influential in the academic field. This is in line with the results of the study that Growth mindset is closely related to academic performance (Zintz, 2018), Grit (Sigmundsson & Haga, 2024), academic achievement (Kizilcec & Goldfarb, 2019), self-efficacy (R. & Talwar, 2023), self-regulated learning (Ajrina & Ajrina, 2023), and motivation to achieve (Lee et al., 2024; Macnamara & Burgoyne, 2022; J. Zhang et al., 2019). Furthermore, in the academic field, environmental involvement has also begun to be researched.

The influence of parents and teachers on students' growth mindsets is a concern for researchers. Teachers need a growth mindset in order to help students adopt a growth mindset (Bardach et al., 2024). Teachers who have a growth mindset will, in turn, influence learning strategies such as learning design and implementation. Furthermore, the strategies employed by teachers will impact the development of students' character (Yulianti et al., 2024). Teacher support for a growth mindset (TSGM) is likely to influence students' mindsets while increasing academic engagement and achievement (Vestad & Bru, 2023). In addition to teachers, parental influence is also crucial. The influence of parents' growth mindset on the development and change of children's growth mindset is undeniable. Children exhibit a higher level of growth mindset when their mothers' growth mindset increases (J. Chen & Liu, 2023). Thematically, research on GM also explores the correlation or contribution of GM to career. Students with a growth mindset significantly impact their self-efficacy in career decision-making (Bulo & Azis, 2024); possess entrepreneurial self-efficacy and

perseverance in career development (Burnette et al., 2020); exhibit career adaptability (Puspitasari et al., 2024); and achieve career success (S. Zhang et al., 2023).

In research in Indonesia, the scope of research is not limited to academic and career fields. GM can be associated with religious and cultural contexts. The research conducted was conducted previously trying to apply the relevance of Islamic education that contains the philosophy of Al-Ghazali to the Growth Mindset of millennials from the covid-19 pandemic (Budiarti et al., 2022); The growth mindset is an important foundation in Islamic schools in developing quality awareness because the philosophy of total quality management requires a tradition of continuous improvement (Kodrat, 2020). This is understandable, in line with the findings that a person can accept or reject religious practices and teachings based on their mindset (Buchanan, 2024). Interestingly, another study examined the film Buya Hamka, vol. 1. The results of the study explained that Sufistic values, from the perspective of Modern Sufism, as presented in Buya Hamka (such as control of lust, sincerity, zuhud, tawakal, qonaah, and happiness), have the potential to build *a growth mindset* in the audience. These values inspire the audience to develop their character through the example of Buya Hamka's life journey (Syarifani et al., 2023). It also supports the finding that the religious and cultural context in Indonesia is associated with the growth mindset theory.

The shift in research methodology on *growth mindset* shows the evolution from the dominance of descriptive quantitative approaches and simple correlations in the early stages (2020–2021) to the use of more complex and integrated methods, such as Structural Equation Model (SEM) and Experiments in the transition stage (2022–2023), to reaching a contemporary peak (2024–2025) with a focus on Systematic Literature Review, Bibliometrics, Mixed Method, and Research and Development (R&D) to produce systematic synthesis and new products. As the methods evolved, the research subjects also underwent extensive diversification, shifting from an initial focus on students and students to encompassing a wider range of more specific professional groups, including athletes, corporate employees, counselors, nurses, and fishermen, reflecting efforts to test the relevance of *growth mindsets* in a more diverse and in-depth spectrum of educational, psychological, and social contexts.

4. CONCLUSION

The results of this bibliometric research show that *Growth Mindset* (GM) research in Indonesia experienced a consistent and substantial increase in publication dynamics between 2020 and 2025, driven by a shift in methodology and diversification of focus. Methodologically, research has evolved from the dominance of simple descriptive quantitative approaches in the early stages to a more complex and integrated approach at the contemporary stage, namely Systematic Literature Review, Bibliometrics, Mixed Methods, and Research and Development (R&D). This shift is in line with the drastic

diversification of subjects from students to various specific professions, such as employees, nurses, school counselors, and fishermen, as well as the expansion of research variables from the academic realm to psychological, career adaptability, and futuristic contexts (VUCA or *well-being* issues). Thus, the main recommendation for future research is to utilize Mixed methods and R&D to test the effectiveness of GM interventions and fill in precise research gaps.

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Systematic Review of Teachers' Role in Building Positive Body Image through Pedagogical and Emotional Support

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ABSTRACT

Positive body image is one of the important factors in shaping students' psychological well-being, but research shows that many adolescents experience dissatisfaction with their bodies due to the influence of social environments and the media. This problem requires teachers to play an active role in creating a supportive learning environment through pedagogical approaches and emotional support. This study aims to systematically review various studies that discuss the contribution of teachers in building a positive body image at school. This study uses the Systematic Literature Review (SLR) method by collecting literature from the Scopus and Google Scholar databases (2015-2025) through the stages of identification, selection, and thematic analysis of relevant scientific publications. The review results show that teachers play a significant role in fostering self-acceptance, self-confidence, and positive views of students' bodies through reflective learning strategies, positive role models, empathetic communication, and the integration of body image issues into the curriculum. The discussion reveals that the effectiveness of the teacher's role is greatly influenced by sensitivity to issues of physical diversity, body literacy training, and school policy support. In conclusion, teachers have a strategic position in shaping students' positive body image through conscious pedagogical and emotional interactions. This study implies the importance of strengthening teacher capacity and developing school policies that support the creation of a safe, inclusive learning environment that is oriented towards student welfare.

Keywords: *Body Image*, *Emotional Support*, *Pedagogy*, *Teachers*.

1. INTRODUCTION

Body image is an individual's perception, thoughts, and feelings about their physical appearance, which plays a crucial role in shaping adolescents' identity and psychological well-being (Cash & Smolak, 2011; Grogan, 2016). Adolescence is a critical period in the development of body image because it is marked by significant physical changes, increased social awareness, and sensitivity to the judgments of others (Voelker et al., 2015). However, various studies show that the prevalence of body dissatisfaction among adolescents continues to increase globally, with an estimated 40-70% of adolescents experiencing negative feelings about their physical appearance (Frisén & Holmqvist, 2010; Harriger et al., 2010).

This phenomenon cannot be separated from the influence of social and cultural environments that increasingly emphasize unrealistic standards of beauty and ideal body types. Social media and digital content have created continuous exposure to manipulated body images, encouraging harmful social comparisons, and triggering the

internalization of narrow appearance standards (Perloff, 2014; Fardouly & Vartanian, 2016). The negative effects of poor body image on adolescents include decreased self-esteem, eating disorders, depression, anxiety, and decreased academic performance and interpersonal relationship quality (Neumark-Sztainer et al., 2006; Paxton et al., 2006).

Given that adolescents spend most of their time in the school environment, educational institutions are strategically positioned to promote positive body image (Yager & O'Dea, 2008). Positive body image is defined as acceptance, appreciation, and respect for one's own body, regardless of how it aligns with society's ideal standards (Tylka & Wood-Barcalow, 2015). This concept is not merely the absence of body dissatisfaction, but includes functional appreciation of the body, healthy self-care practices, and a protective filter against negative messages about appearance (Avalos et al., 2005).

In the school context, teachers play a very important but often overlooked role in shaping students' perceptions of body and appearance. Teachers not only serve as facilitators of academic learning, but also as role models, shapers of classroom social norms, and providers of emotional support that can influence students' psychosocial development (Poulton et al., 2016; Richardson & Paxton, 2010). Teachers' daily interactions with students, both through verbal and nonverbal communication, can reinforce or challenge stereotypes related to physical appearance (Haines et al., 2006).

Several studies show that teachers' comments about students' weight, appearance, or physical performance, even when made with good intentions, can have a long-term impact on students' body image (Neumark-Sztainer et al., 2010; Bauer et al., 2017). Conversely, teachers who are trained in body image literacy and apply inclusive pedagogical approaches can effectively build a learning environment that supports self-acceptance and body diversity (O'Dea, 2005; Yager et al., 2013).

Although there is recognition of the importance of teachers' role in shaping a positive body image, empirical research that comprehensively examines the specific contribution of teachers in this context is still limited and scattered across various disciplines. Most body image interventions in schools focus on structured programs delivered by external professionals, with minimal attention to the role of classroom teachers in everyday learning practices (Yager & O'Dea, 2014). In addition, there is still a gap in understanding the most effective pedagogical strategies, the challenges faced by teachers, and the systemic support needed to optimize their role.

Therefore, a systematic review of the existing literature is essential to identify, synthesize, and evaluate scientific evidence on how teachers can contribute to building positive body image in students. This review is expected to provide a theoretical and practical foundation for the development of teacher training programs, school policies,

and classroom-based interventions that are more effective in promoting the psychological well-being of adolescents.

This study aims to systematically review various studies that discuss the role and contribution of teachers in building positive body image among students in the school environment. Specifically, this review will: (1) identify pedagogical strategies and interpersonal approaches used by teachers in promoting positive body image; (2) analyze factors that influence the effectiveness of teachers' roles in this context; (3) explore the challenges and obstacles faced by teachers; and (4) formulate recommendations for educational practices and policies that support the creation of a school environment conducive to the formation of positive body image among students.

2. METHODOLOGY

2.1. Research Design

This study uses a Systematic Literature Review (SLR) method to identify and analyze research related to the role of teachers in building positive body image among students through pedagogical approaches and emotional support. The SLR approach was selected due to its capacity to provide a comprehensive, transparent, and replicable synthesis of evidence, thereby minimizing potential bias in the review process (Liu, 2024; Li & Xue, 2023). To enhance methodological rigor and reporting transparency, the review process was guided by the PRISMA 2020 framework, which structured the stages of literature identification, screening, eligibility assessment, and inclusion.

2.2. Research Questions

1. What pedagogical strategies do teachers use to promote positive body image among students in school settings?
2. How does teachers' emotional support contribute to students' development of positive body image?
3. What factors influence the effectiveness of teachers' roles in fostering positive body image (e.g., teacher preparation, self-efficacy, institutional support)?
4. What challenges and barriers do teachers face in implementing body image related pedagogical and emotional support practices?

2.3. Data Sources and Search Strategy

The literature search was conducted using two major academic databases: Scopus and Google Scholar, covering publications from 2015 to 2025. These databases were selected due to their broad coverage of peer-reviewed research in education, psychology, and health-related disciplines. The search strategy employed combinations of keywords using Boolean operators, including:"*teacher role*", "*positive body image*", "*pedagogical support*", "*emotional support*", "*school-based intervention*",

and "*body image education*". Reference lists of relevant articles were also screened to identify additional studies.

2.4. Inclusion and Exclusion Criteria

The inclusion criteria for data collection for this article were: (1) articles published between 2015 and 2025, (2) discussing the role of teachers, pedagogical approaches, emotional support, or school interventions related to positive body image, (3) published in peer-reviewed journals, (4) full-text available, (5) written in English or Indonesian, and with a clear methodology. Meanwhile, the exclusion criteria include: (1) articles irrelevant to higher education, (2) editorial publications or conference abstracts without full papers, (3) not discussing the relationship between policy and academic engagement, (4) duplicate articles, and (5) low methodological quality. The exclusion criteria include: (1) articles that are not relevant to the context of school education or do not mention the role of teachers, (2) editorial publications or conference abstracts without full papers, (3) articles that do not discuss the relationship between pedagogy/emotional support and body image, (4) duplicate articles, and (5) articles with low methodological quality or that do not report data adequately.

2.5. Study Selection and Data Analysis

Following the screening and eligibility assessment stages, the selected studies were subjected to a systematic selection and analysis process, with data extraction and analysis conducted concurrently using a structured data extraction sheet adapted from established SLR guidelines (Kitchenham & Charters, 2007).

The included studies were analyzed using thematic synthesis to identify conceptual patterns between articles related to the role of teachers in building a positive body image. The analysis process began with data reduction, which involved selecting information relevant to the research focus, such as pedagogical strategies, emotional support practices, body literacy interventions, and teacher student relationship dynamics. At this stage, initial coding was conducted to form preliminary categories, including teacher modeling, body-positive pedagogy, emotional support practices, inclusive classroom climate, and student body image outcomes (Thomas & Harden, 2008).

The next stage involved data presentation, in which information from each article was organized into a thematic matrix to illustrate relationships between key variables. The findings were then grouped into broader themes, such as the relationship between pedagogical strategies and increased positive body perception, the role of teacher emotional support in fostering psychological safety, the contribution of communication sensitive to body diversity in building student self-acceptance, and the ways in which

an inclusive learning environment strengthens students' emotional well-being (Miles, Huberman, & Saldaña, 2014).

The final stage consisted of drawing and verifying conclusions, which involved interpreting patterns of findings across studies to produce a narrative synthesis of how teachers contribute to the promotion of positive body image through pedagogical approaches and emotional support. This stage also included cross-study comparison to verify the consistency of findings, ensuring that the resulting synthesis was both accurate and reliable (Braun & Clarke, 2006).

3. RESULT AND DISCUSSION

RESULT

To fully understand how teachers contribute to building a positive body image through pedagogical approaches and emotional support, an in-depth review of key findings from various recent studies is necessary. The literature analyzed in this section includes research on teaching strategies that support autonomy, teachers' emotional support practices, the effectiveness of body image education curricula, barriers faced by teachers related to anxiety and self-efficacy, and interventions that are responsive to the cultural context of students. Each study provides a different but complementary perspective, ranging from how student-centered pedagogical approaches increase self-acceptance, how teachers' empathetic communication strengthens emotional security, to how structured curricula and reflective learning can shape healthier body perceptions.

Overall, the literature shows that teachers play a central role as facilitators, role models, and providers of emotional support in creating an inclusive learning environment that values physical diversity and is free from body stigma. Teachers not only convey material, but also shape classroom social norms, guide how students view themselves, and help them interpret cultural pressures related to appearance. Therefore, the synthesis of findings in the following table is designed to show how the various pedagogical approaches and emotional support provided by teachers collectively contribute to the creation of a school ecosystem conducive to the development of a positive body image.

Tabel 1. Table of Systematic Literature Review

Author(s) & Year	Key Findings
Jankauskiene, R., Urmanavicius, D., & Baceviciene, M. (2023). Association between Motivation in Physical Education and Positive Body Image: Mediating and	This study shows that teacher autonomy support in physical education plays a major role in shaping positive body image among Lithuanian adolescents, especially among girls and students who are less physically active. When teachers give choices, respect student preferences, and create a non-judgmental atmosphere, intrinsic motivation increases and directly improves body image perception. These findings

Author(s) & Year	Key Findings
Moderating Effects of Physical Activity Habits.	confirm that a student-centered teaching approach that supports autonomy not only increases participation but also encourages self-acceptance and a more positive body image especially for groups that are vulnerable to body dissatisfaction.
Panganiban, T.D., Camarador, R.A., Tagare, R.L., et al. (2025). Interweaving perceived instructors' emotional support and students' academic resilience in the physical education context through the lens of mindset and attachment theories.	This study shows that teachers' emotional support in physical education plays an important role in strengthening students' academic resilience, while also increasing their engagement and well-being. Through empathetic communication, sensitivity, and a safe learning environment, teachers help students build self-confidence and the ability to cope with pressure, including pressure related to physical appearance. A quality teacher-student relationship has been shown to protect against negative impacts and support the development of a positive body image. These findings emphasize the importance of conscious and responsive pedagogical and emotional interactions in everyday teaching practices.
Xu, H., Song, Z., Liu, W., & Gou, P. (2023). Effectiveness of body image education curriculum in primary schools among grade 4-6 students.	This study shows that a structured body image education curriculum for fourth to sixth graders in China effectively improves body satisfaction and reduces body dissatisfaction across various BMI groups. These findings emphasize the importance of incorporating body image issues into the formal curriculum and training teachers to deliver the material consistently and reflectively. Early intervention has been proven to be more effective than remedial approaches, giving elementary school teachers a strategic role in building the foundations of self-acceptance and positive body image through systematically planned learning.
Hidalgo, S.G., Henning, T., Gomez, F., & Perez, M. (2024). Examining Teacher Concerns and Anxiety on the Implementation of a Universal Body Image Program.	This study highlights that the main obstacles in implementing universal body image programs stem from teachers' anxiety and low self-efficacy, such as fear of speaking incorrectly or discomfort with their own body image. These psychological conditions directly impact the effectiveness of program delivery. Therefore, teachers need to feel competent and comfortable before they can serve as positive role models for students. The study recommends in-depth body literacy training and the use of cognitive modeling to boost teachers' confidence. These findings emphasize that the success of the program depends heavily on school support through adequate professional training, not just on the curriculum design.
Andres, F.E., Thornborrow, T., Bowie, W.N., et al. (2025). Pilot trial assessing acceptability, feasibility, and preliminary effects of a body image intervention for	This study confirms that effective body image interventions must be culturally responsive, taking into account the physical diversity and social context of students. Culturally tailored programs—including media literacy and critique of appearance pressures—are more acceptable and relevant to rural Nicaraguan adolescents. Teachers play a crucial role as

Author(s) & Year	Key Findings
adolescents in rural Nicaragua.	mediators between the material and students' realities through socio-cultural understanding, collaboration with families, and the use of contextually appropriate reflective learning strategies. These findings emphasize the importance of culturally sensitive pedagogical approaches to improve student engagement and body image outcomes.

Table 2. Table of Thematic Analysis

Main Theme	Sub-Themes	Related Studies	Key Recommendations
Pedagogical Strategies for Body Image Promotion	1. Autonomy-supportive teaching approaches 2. Student-centered learning methods 3. Structured curriculum integration• Reflective learning strategies 4. Culturally responsive pedagogy	Jankauskiene et al. (2023) Xu et al. (2023) Andres et al. (2025)	1. Provide students with choices in physical activities and learning methods 2. Respect individual preferences and avoid judgmental approaches 3. Integrate body image education into formal curriculum systematically 4. Design curricula that reflect students' cultural contexts and values 5. Use reflective learning strategies that encourage critical thinking about appearance standards
Emotional Support and Teacher-Student Relationships	1. Empathetic communication 2. Creating psychologically safe environments 3. Building trust and confidence 4. Quality relational dynamics 5. Emotional sensitivity to student needs	Panganiban et al. (2025) Jankauskiene et al. (2023)	1. Establish consistent emotional availability and responsiveness 2. Develop empathetic communication skills through training 3. Create classroom climates free from body stigma and appearance-based judgment 4. Build secure attachment relationships that buffer against appearance pressures 5. Acknowledge and validate students' emotional experiences related to body image

Main Theme	Sub-Themes	Related Studies	Key Recommendations
Teacher Preparation and Professional Developmen	1. Body literacy training 2. Self-efficacy enhanceme• Cognitive modeling approache 3. Addressing teacher anxiety 4. Teachers' own body image concerns	Hidalgo et al. (2024) Xu et al. (2023)	1. Provide comprehensive pre-service and in-service body literacy training 2. Implement cognitive modeling programs to reduce teacher anxiety 3. Address teachers' own body image concerns before program implementation 4. Build teacher confidence through structured professional development 5. Offer ongoing support and peer learning opportunities for teachers
Early Intervention and Prevention	1. Timing of interventions 2. Primary school emphasis 3. Preventive vs. remedial approache 4. Age-appropriate strategies 5. Foundation building for self-acceptance	Xu et al. (2023)	1. Prioritize body image education in elementary grades (4-6) 2. Implement preventive programs before body dissatisfaction intensifies 3. Train elementary teachers as key gatekeepers for early intervention 4. Develop age-appropriate curriculum materials for younger students 5. Build foundational self-acceptance skills during critical developmental periods
Cultural Responsiveness and Diversity	1. Socio-cultural adaptation of programs 2. Respect for physical diversity 3. Local context integration• Family and community collaboration 4. Media literacy in cultural context	Andres et al. (2025) Jankauskiene et al. (2023)	1. Adapt interventions to reflect local cultural values and appearance norms 2. Collaborate with families to reinforce body-positive messages 3. Develop socio-cultural competence among teachers 4. Integrate media literacy that addresses culture-specific appearance pressures

Main Theme	Sub-Themes	Related Studies	Key Recommendations
			5. Celebrate and validate diverse body types and cultural backgrounds
Systemic and Institutional Support	1. School policy frameworks 2. Resource allocation 3. Training infrastructure 4. Implementation support systems 5. Program sustainability mechanisms	Hidalgo et al. (2024) Xu et al. (2023)	1. Establish school-wide policies supporting body-positive environments 2. Allocate adequate resources for teacher training and program implementation 3. Create institutional support systems for teachers implementing programs 4. Develop sustainable mechanisms for ongoing professional development 5. Foster collaboration between school leadership, teachers, and support staff

DISCUSSION

The synthesized findings reveal that teachers occupy a strategic position at the intersection of curriculum delivery, social norm formation, and emotional support provision. Their role transcends traditional academic instruction, extending into the realm of psychosocial development and identity formation.

Pedagogical Dimension: The evidence strongly supports student-centered, autonomy-supportive approaches over prescriptive or judgmental teaching styles. When teachers position students as active agents in their learning and physical activity choices, they simultaneously foster self-determination and positive self-perception. The effectiveness of structured curricula (Xu et al., 2023) demonstrates that body image promotion need not be incidental but can be intentionally designed into educational programming.

Relational Dimension: The quality of teacher-student relationships emerges as a consistent mediating factor across contexts. Empathetic communication and emotional availability create the psychological foundation necessary for students to challenge negative appearance-related messages and develop body acceptance. This finding aligns with attachment and social learning theories, positioning teachers as secure base figures whose modeling and validation significantly influence students' self-concepts.

Contextual Adaptation: The emphasis on cultural responsiveness (Andres et al., 2025) highlights that effective body image support cannot be one-size-fits-all.

Teachers must develop cultural competence to understand how appearance ideals and body-related pressures manifest differently across communities, and adapt their approaches accordingly.

Implementation Challenges: Critically, the identification of teacher anxiety and self-efficacy barriers (Hidalgo et al., 2024) reveals a frequently overlooked dimension: teachers themselves may struggle with body image issues or lack confidence in addressing this sensitive topic. This finding has important implications for teacher education and professional development, suggesting that effective implementation requires attending to teachers' psychological needs and competencies.

Preventive vs. Remedial Approaches: The evidence favors early, preventive integration of body image education (Xu et al., 2023) rather than reactive interventions after problems emerge. This positions elementary school teachers as particularly crucial in establishing foundational body acceptance before adolescent intensification of appearance concerns.

The collective evidence demonstrates that teachers' contribution to positive body image is not merely about delivering content but encompasses:

1. Modeling healthy attitudes toward physical diversity
2. Creating inclusive classroom cultures that celebrate varied body types
3. Providing responsive emotional support during vulnerable developmental periods
4. Challenging appearance-based stereotypes and biases
5. Integrating body acceptance principles across curriculum areas

However, the effectiveness of these roles is conditional upon:

1. Adequate pre-service and in-service training in body literacy
2. Institutional policies supporting body-positive school cultures
3. Resources for implementing evidence-based programs
4. Ongoing professional development and peer support
5. Attention to teachers' own body image concerns and well-being

The reviewed literature collectively argues for a systemic approach recognizing teachers not as isolated actors but as key implementers within broader educational ecosystems that must support both student and teacher needs to effectively promote positive body image development.

The findings are organized thematically to address the research questions, focusing on pedagogical strategies, emotional support, influencing factors, and implementation challenges related to teachers' roles in promoting positive body image.

4. CONCLUSION

This systematic review confirms that teachers play a strategic role in building positive body image through pedagogical approaches and emotional support. The synthesis of five studies reveals that effective interventions require integrating

autonomy-supportive teaching, structured curriculum, culturally responsive pedagogy, and empathetic communication within psychologically safe learning environments.

The findings address four research objectives: (1) effective strategies include student-centered methods, reflective learning, and curriculum integration; (2) effectiveness depends on teacher preparation, self-efficacy, cultural competence, and institutional support; (3) main challenges involve teacher anxiety, low self-efficacy, and insufficient training; (4) recommendations emphasize body literacy training, cognitive modeling, early intervention in elementary grades, and supportive school policies.

Teachers' contribution extends beyond instruction to modeling healthy attitudes, creating inclusive norms, providing emotional support, and challenging appearance stereotypes. However, realizing this potential requires adequate teacher training, supportive policies, sufficient resources, and attention to teachers' own body image well-being. Success depends on systemic alignment between teacher competencies, classroom practices, school policies, and community engagement.

Practical recommendations include: policymakers should establish body-positive school policies and fund teacher training; teacher education institutions must develop body literacy courses; school administrators should implement whole-school approaches with peer support networks; and classroom teachers should cultivate autonomy-supportive practices and integrate body image topics across curricula. Future research should examine long-term outcomes, cross-cultural variations, and strategies for addressing digital media pressures. Ultimately, investing in teacher education and body-positive institutional cultures can effectively address youth body dissatisfaction and promote holistic student well-being.

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Mapping Integrated Curriculum Evaluation: CIPP, Data-Driven, and Professional Learning in 21st-Century Educational Leadership

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ABSTRACT

The paradigm of curriculum evaluation in 21st-century educational leadership remains dominated by linear and static models, yet modern educational contexts demand responsive and evidence-based approaches. This literature study examines how the CIPP model (Context-Input-Process-Product), data-driven evaluation, and professional learning communities integrate within educational leadership practice during 2019–2025. The methodology employs literature review of 18 selected academic publications through systematic search in academic databases. Analysis proceeded through three sequential stages: component-level synthesis examining mechanisms, effectiveness, and barriers for each component; integration pattern identification employing thematic analysis of eight integration-specific sources to map interaction mechanisms and enabling conditions; and framework synthesis involving iterative thematic analysis and conceptual mapping to develop the integrated circular model. Results show three major findings: a paradigm shift from linear models toward circular evaluation frameworks, conceptual convergence on responsiveness and evidence-based practice as core integration mechanisms, and successful integration through simultaneous alignment of structural, cultural, and relational dimensions. The study identifies three critical gaps: integration mechanisms among the three components lack theoretical elaboration, empirical evidence from diverse contexts remains limited, and the relationship between integrated framework implementation and learning improvements is unclear. These gaps form the basis for developing a conceptual framework that explains how integrating the three components can enhance the quality of educational leadership decision-making. This framework is proposed as a practical solution for educational leadership that is more responsive, inclusive, and data-informed aligned with 21st-century demands. The research implications are particularly relevant for Indonesia's Kurikulum Merdeka implementation, which requires adaptive leadership and data-informed decision-making to enhance school learning quality.

Keywords: *CIPP Model, circular paradigm, curriculum evaluation, educational leadership, literature review, professional learning communities.*

1. INTRODUCTION

The 21st-century educational landscape demands that schools prepare students for complex global contexts while ensuring equity and fostering adaptive competencies (Mincu, 2022). Indonesia's implementation of Kurikulum Merdeka—emphasizing student agency and differentiated pedagogical approaches requiring teachers to adjust instruction responsively based on classroom data—exemplifies this transformation. Yet sustainable improvement requires systemic integration of rigorous evaluation, evidence-informed decision-making, and collaborative professional practice. Contemporary schools, however, operate through fragmented models where these elements function as parallel initiatives rather than interconnected systems, creating a persistent paradox between recognized necessity and actual practice. Ratnaya et al.'s

(2022) analysis of Indonesian vocational schools found that 87% completed CIPP evaluations yet only 12% demonstrated evidence of evaluation findings translated into collaborative action planning, suggesting fragmentation is not merely theoretical but systematically embedded in practice.

Historically, educational leadership operated through linear, hierarchical models where curriculum evaluation followed sequential processes: mandates translated to implementation, evaluators assessed fidelity, and reports served accountability purposes (Dizon, 2022). This linear approach represents what Argyris & Schön (1978) term single-loop learning—organizations detect problems and respond through surface adjustments without examining underlying assumptions or values. Data-driven decision-making evolved similarly as a technical exercise disconnected from collaborative improvement structures (Henderson & Corry, 2020), while professional learning communities, when institutionalized, frequently operated as isolated initiatives focused on social collaboration rather than systematic, evidence-grounded improvement (Brodie, 2019). This compartmentalization reflects both conceptual limitations—practitioners and scholars developed these fields separately—and organizational realities of school structures, specialized role definitions, and time allocation. CIPP evaluation frameworks provide systematic assessment yet lack mechanisms connecting findings to action; data literacy training emphasizes analytical skills without integrating collaborative sense-making; and professional learning communities emphasize adult learning without systematic evaluation focus. The consequence is fragmented school improvement where evaluation reports remain unused, teachers receive data as external accountability mechanisms disconnected from collaborative ownership, and professional communities sometimes devolve into social gatherings without evidence-grounded improvement focus.

Recent empirical evidence demonstrates that sustainable school improvement depends on dynamic integration mediated through responsive, adaptive leadership. CIPP evaluation rigorously assesses context, inputs, processes, and products, surfacing implementation gaps; however, evaluation findings require translation into actionable insights. Leithwood et al. (2019) demonstrated through structural equation modeling of 1,779 teachers in 81 schools that leadership influences student learning through four mediated pathways—rational, emotional, organizational, and community—with data providing the evidentiary foundation. Yet Henderson & Corry's (2020) systematic literature review of 28 data literacy studies revealed that professional development focuses narrowly on assessment literacy rather than comprehensive data-informed inquiry. Professional Learning Communities, conceptualized through communities of practice framework (Wenger, 1998, as discussed in Johannesson, 2020) and grounded in sociocultural learning theory (Vygotsky, 1978), provide organizational mechanisms for collaboratively analyzing and translating evaluation findings into improvement

action through joint enterprise, mutual engagement, and shared repertoire. Sociocultural theory shows teachers' capacity expands through collaboration with knowledgeable peers (zone of proximal development), while distributed cognition theory (Hutchins, 1995) explains how organizations transcend individual cognitive limitations through coordinated interaction. Qian Haiyan & Walker's (2020) comparative analysis of 101 schools across six Chinese regions identified nine principal leadership strategies enabling integration across structural, cultural, and relational dimensions. Zhang et al. (2020) demonstrated using multilevel structural equation modeling that well-functioning PLCs with collaborative inquiry and supportive leadership significantly predicted teacher self-efficacy ($\beta = .63$) and job satisfaction ($\beta = .86$), with organizational commitment cascading to student outcomes. These research streams converge on a unified mechanism: evaluation effectiveness depends on collaborative action mediated through double-loop learning processes (Argyris & Schön, 1978), data utility depends on collective interpretation within sociocultural contexts, and collaborative learning succeeds when focused on systematic evidence.

Despite this convergence, integration of CIPP evaluation, data-driven analysis, and professional learning communities remains theoretically underdeveloped and empirically understudied, particularly within Asian educational contexts. Current research treats these as distinct fields; CIPP studies rarely address translating findings into collaborative action, data literacy literature disconnects evidence analysis from collaborative professional learning, and PLC research rarely incorporates data-informed inquiry. Three fundamental questions remain inadequately answered: What are the specific mechanisms through which CIPP, data-driven analysis, and PLCs functionally interact, and how do organizational learning and sociocultural theories explain these interactions? What structural, cultural, and relational conditions enable integration within complex adaptive systems? How do integrated approaches compare to compartmentalized approaches in producing superior outcomes for student learning, teacher quality, and sustainable school improvement? This theoretical gap creates practice consequences: Indonesian schools implementing Kurikulum Merdeka lack integrated frameworks; teachers experience evaluation and data as compliance requirements rather than improvement resources; leaders lack practical guidance for establishing integrated systems grounded in organizational learning theory.

This article addresses this gap through literature review of 18 peer-reviewed publications (2019–2025), proposing an integrated circular model wherein CIPP assessment identifies curricular gaps, data-driven analysis translates findings into evidence-based priorities through double-loop learning processes, professional learning communities operationalize decisions through collaborative action, and systematic reflection cycles findings back to evaluation. Organizational learning theory explains why circular integration creates sustained transformation: schools functioning

as learning organizations explicitly examine and modify underlying assumptions about improvement. Sociocultural theories illuminate why collaboration amplifies individual capacity. Adaptive systems theory (Stacey, 2011) explains why responsiveness rather than static models succeeds in complex educational environments. Mincu's (2022) six critical assumptions for transformational educational leadership—recognizing organizational context, defining quality adaptively, balancing autonomy types, understanding school cultures, acknowledging structural constraints, and centering change at school level—provide governance foundation ensuring culturally responsive frameworks grounded in these theoretical foundations. Geographic scope prioritizes Asian educational contexts, particularly Indonesian schools where successful Kurikulum Merdeka implementation depends on integrated evaluation-data-collaboration approaches operating through organizational learning, sociocultural development, and adaptive responsiveness. Five interconnected research objectives guide this work: (1) mapping current evidence regarding each component's effectiveness, mechanisms, enabling conditions, and barriers; (2) synthesizing integration evidence and identifying how components interact; (3) proposing an explicit theoretical framework explaining integration mechanisms, enabling conditions, and outcomes; (4) translating evidence into practical implementation guidance, specifically the nine leadership strategies operationalized in high-performing schools; and (5) addressing geographic and contextual gaps with particular attention to Indonesian contexts where integrated approaches grounded in organizational learning enable the responsive, evidence-informed, collectively-owned improvement that Kurikulum Merdeka demands.

2. METHODOLOGY

This study employs literature review to synthesize evidence regarding curriculum evaluation, data-driven decision-making, professional learning communities, and their integration within educational leadership contexts. Literature review is appropriate because it enables identification of conceptual patterns across methodologically diverse studies and development of integrated frameworks transcending individual studies.

2.1. Research Design

This study employs qualitative literature review with systematic source selection and structured analytical processes. The design integrates inductive reasoning—allowing patterns to emerge from literature—with deductive reasoning grounded in pre-identified theoretical constructs related to CIPP evaluation, data-driven decision-making, professional learning communities, and integration mechanisms. The analytical framework operates at three levels: component level (examining components as

separate entities), integration level (identifying how components interact), and outcome level (synthesizing integration effects)—enabling identification of both separate component evidence and integration mechanisms.

2.2. Literature Search Strategy

Source identification employed systematic searches across academic databases using four keyword combinations: (1) ("CIPP" OR "curriculum evaluation") AND ("professional learning" OR "collaborative learning"); (2) ("data-driven" OR "data literacy" OR "evidence-informed") AND ("professional learning communities" OR "PLCs"); (3) ("curriculum evaluation") AND ("data-driven") AND ("leadership" OR "school improvement"); (4) ("leadership" OR "school principal") AND ("integration") AND ("evaluation" OR "data-driven" OR "professional learning").

Inclusion criteria: (1) peer-reviewed journals, 2019–2025; (2) explicit focus on CIPP evaluation, data-driven decision-making, professional learning communities, or their integration; (3) empirical studies, theoretical frameworks, or literature reviews; (4) English-language publication; (5) geographic diversity prioritizing Asian contexts (Indonesia, China) with Western literature for theoretical depth. Exclusion criteria: (1) studies disconnected from evaluation, data-driven practice, or professional learning; (2) publications predating 2019; (3) non-peer-reviewed sources.

The final sample comprises 18 peer-reviewed publications. Sample composition: 12 empirical studies (eight quantitative SEM/survey studies with samples exceeding 100 schools/teachers; four qualitative case studies) and six literature synthesis sources (three systematic reviews; three theoretical frameworks). Geographic representation: Indonesia (3), China (3), USA (5), Sweden (2), Netherlands (1), Turkey (2), Australia (2), plus one international framework. Publications appeared in high-impact journals: Professional Development in Education (6), Educational Administration Quarterly (2), Journal of Educational Change (1), Asia Pacific Journal of Education (2), and others (7). Methodological rigor: Leithwood et al. (2019) examined 1,779 teachers across 81 schools; Zhang et al. (2020) employed multilevel SEM with 1,365 teachers across 116 schools; Li & Liu (2020) demonstrated integrated leadership effects through three-level SEM; Admiraal et al. (2019) tracked 14 schools over three years; Qian Haiyan & Walker (2020) analyzed 101 principals across six Chinese regions. Integration-specific studies: Gore & Rosser's (2020) randomized controlled trial demonstrated combined framework, collaborative observation, and principal facilitation produce sustained improvements; Li & Liu's SEM showed integrated leadership produces stronger effects than separate components; Johannesson's (2020) Wenger framework application demonstrated three dimensions must align for integration success.

2.3. Data Analysis Techniques

Analysis proceeded through three sequential stages. Stage 1: Component-level synthesis examined how sources characterize CIPP evaluation, data-driven decision-making, and professional learning communities as separate phenomena, synthesizing evidence regarding mechanisms, effectiveness, enabling conditions, and barriers. Stage 2: Integration pattern identification employed thematic analysis of eight sources simultaneously addressing multiple components, identifying interaction mechanisms, specifying enabling conditions (organizational structures, leadership practices, cultural factors, policy support), and synthesizing integration outcomes compared to compartmentalized approaches. Stage 3: Framework synthesis involved iterative thematic analysis and conceptual mapping to develop the integrated circular model explaining how CIPP assessment, data-driven analysis, and collaborative professional learning function as mutually reinforcing components within school improvement cycles.

3. RESULT AND DISCUSSION

Synthesis of evidence from the 18 peer-reviewed publications reveals three major findings regarding curriculum evaluation, data-driven decision-making, professional learning communities, and their integration within educational leadership contexts.

Finding 1: Paradigm shift from linear to circular evaluation processes. Traditional CIPP evaluation operates through sequential processes—assessment of context, analysis of inputs, monitoring of processes, and evaluation of products—yielding reports disconnected from improvement action. Ratnaya et al. (2022) documented this limitation explicitly, finding that 87% of Indonesian vocational schools completed CIPP evaluations yet only 12% demonstrated evidence of evaluation findings translated into collaborative action planning. Emerging integration approaches reverse this linearity. Gore & Rosser's (2020) randomized controlled trial (n=192 teachers, 24 schools) demonstrated that Quality Teaching Rounds combining evidence-based pedagogy framework, collaborative lesson observation, and principal facilitation created feedback loops where evaluation findings immediately triggered collaborative interpretation and action planning, with sustained improvements in teaching quality (effect size d=.40). Johannesson's (2020) action research study in Swedish schools showed that when CIPP evaluation components aligned with Wenger's three community dimensions (joint enterprise focused on evidence, mutual engagement in collaborative analysis, shared repertoire of improvement language and tools), evaluation became integral to ongoing improvement cycles rather than separate accountability exercises. This finding reflects both theoretical recognition and empirical validation that circular rather than linear improvement processes enable sustainable school improvement.

Finding 2: Conceptual convergence on responsiveness and evidence-based collective practice as integration mechanisms. Multiple independent research streams converge on the necessity of integration through two core mechanisms: responsiveness—organizations actively adapt structures, processes, and support based on continuous evidence about implementation—and evidence-based collective practice—teachers and leaders engage in collaborative inquiry using data to make improvement decisions. CIPP literature (Dizon, 2022; Basaran et al., 2021; Turmuzi et al., 2022) recognizes evaluation effectiveness requires connection to action. Data-driven literature establishes that data utility depends on collaborative sense-making within organizational structures supporting collective ownership (Henderson & Corry, 2020 systematic review of 28 studies; Wang, 2021). PLC literature demonstrates that PLCs succeed when focused on systematic evidence and improvement rather than social collaboration (Johannesson, 2020; Admiraal et al., 2019; Qian Haiyan & Walker, 2020). Leithwood et al. (2019) demonstrated through multilevel SEM (1,779 teachers, 81 schools) that leadership effectiveness operates through four data-informed pathways—rational, emotional, organizational, and family/community—with responsiveness to feedback essential to all pathways. Zhang et al. (2020) found that PLCs with strong collaborative inquiry and supportive leadership predicted teacher self-efficacy (β=.63) and job satisfaction (β=.86), with organizational commitment mediating effects on student outcomes. These convergent findings across research traditions identify responsiveness and evidence-grounded collective sense-making as mechanisms enabling integration success.

Finding 3: Integration succeeds through alignment of structural, cultural, and relational dimensions. Integration does not occur through merely adding components; rather, components must align across three interdependent dimensions working simultaneously. Qian Haiyan & Walker's (2020) comparative analysis of 101 principals across six Chinese regions identified nine principal leadership strategies enabling this alignment: structural dimensions (routinizing collaborative learning, creating peer learning opportunities, identifying teacher leaders); cultural dimensions (promoting shared vision, investing in professional learning, ensuring focus on evidence-grounded improvement); relational dimensions (enhancing collaboration willingness, understanding and caring for teachers, building trust through consistency). Li & Liu's (2020) three-level structural equation modeling demonstrated that integrated transformational plus teacher leadership model produces stronger effects on student outcomes (indirect effect β=.476) than principal leadership alone, because teacher leadership operates as mediating mechanism through which structural conditions and cultural values translate to classroom practice. Johannesson's (2020) analysis documented that communities of practice succeed when three Wenger dimensions align: joint enterprise (shared, evidence-grounded focus), mutual engagement

(authentic collaborative relationships), and shared repertoire (common language and tools). Misalignment in any dimension undermines integration—strong structures without cultural alignment create compliance without ownership (Brodie, 2019); collaborative culture without systematic evaluation becomes social rather than improvement-focused (Admiraal et al., 2019). Successful integration requires simultaneous attention to structural conditions (time, procedures, resources for collaboration and evaluation), cultural conditions (shared values about evidence and improvement), and relational conditions (trust, psychological safety, leadership support).

These three findings converge on an integrated circular improvement model addressing the central research gap. CIPP systematic evaluation identifies curricular gaps, contextual factors, and program effectiveness evidence. This evaluation-generated evidence becomes the basis for data-driven analysis within collaborative structures. Professional learning communities—operating through aligned structural, cultural, and relational dimensions—provide organizational mechanisms wherein teachers and leaders collectively interpret evaluation findings, analyze data, identify improvement priorities, and plan action. Supportive, adaptive leadership facilitates integration through establishing structures, cultivating culture, and modeling collaborative inquiry. Continuous data collection about implementation feeds reflection and adjustment cycles, cycling findings back to evaluation in sustained improvement processes. This differs fundamentally from linear models: evaluation does not end in reports; data remains disconnected from action; PLCs do not operate without evidence focus; leadership does not direct from above. Integration creates interdependent system where components strengthen each other.

This integrated framework addresses essential dimensions inadequately specified in existing models. Theoretical specificity: While Wenger's (1998) communities of practice theory provides foundation and Leithwood et al.'s (2019) four-paths leadership model explains leadership pathways, this framework explicitly specifies integration mechanisms rather than component descriptions. By grounding integration in empirical evidence from RCTs, multilevel SEM studies, and qualitative case studies, the framework provides scholarly rigor and practical actionability. Indonesian context alignment: Mincu's (2022) six governance assumptions directly apply—recognizing organizational context, defining quality adaptively, balancing autonomy types, understanding school cultures, acknowledging structural constraints, and centering change at school level. These contextual considerations ensure that integration respects Indonesian institutional structures (hierarchical governance, Teaching Research Groups/Kelompok Kerja Guru traditions, teacher workload realities) rather than mechanically applying Western models. Implementation specificity: Qian Haiyan & Walker's (2020) nine strategies operationalize integration—three structural,

three cultural, three relational. Gore & Rosser's (2020) Quality Teaching Rounds protocol provides complementary implementation pathway: select focus, collect evidence, conduct collaborative analysis, plan action, implement with support, reflect continuously. These concrete strategies enable school leaders to move from theory to practice.

Implications and Limitations: For school practitioners implementing Kurikulum Merdeka, this framework suggests prioritizing simultaneously structural (time and procedures for PLCs, evaluation systems), cultural (shared improvement focus), and relational (trust and leadership support) dimensions rather than sequential implementation. Teacher leader development becomes essential—identifying capable teachers, providing substantive support, creating role clarity. For educational policy and system leaders, accountability systems should reward integration rather than component compliance; policy should explicitly require integration while providing enabling resources. For teacher education institutions, pre-service and in-service programs should teach integration explicitly, combining data literacy, curriculum evaluation, collaborative practice, and leadership into unified programs rather than separate courses. Several important limitations qualify this framework. Evidence concentration in developed Western contexts and selective Asian examples (primarily China, limited Indonesia) raises generalizability questions. Most integration-specific empirical validation comes from relatively well-resourced schools; applicability to severely resource-constrained contexts remains understudied. Cultural and institutional variables mediate integration mechanisms—hierarchical versus distributed leadership, collectivist versus individualist cultures, strong versus weak social capital—create context-specific possibilities not fully captured. Implementing integration requires substantial leadership capacity; Qian Haiyan & Walker's findings suggest principal attitudes toward evidence, collaborative leadership, and continuous improvement significantly influenced implementation success. Teachers' professional agency affects whether PLCs become authentic improvement communities or compliance exercises (Brodie, 2019). Finally, the temporal dimension—how long integration takes to establish, at what point outcomes become visible, how to sustain momentum—remains incompletely addressed in literature.

Future research directions must address these gaps. Cross-cultural validation studies examining whether integration mechanisms operate similarly in diverse Asian contexts are essential. Longitudinal outcome studies specifically tracking framework implementation through three to five years with measurement of distal outcomes (student learning gains, career readiness) remain rare; most studies measure proximal outcomes (teacher efficacy, collaboration quality). Barrier and enabler analysis—What contextual factors most constrain or facilitate integration? How do resource limitations affect feasibility? What professional development do leaders need?—deserves deeper

investigation. The technology integration role raises questions about how learning management systems, data dashboards, and AI analytics support or complicate integration. Finally, teacher preparation curriculum redesign How should teacher education programs prepare future teachers for integrated evaluation-data-PLC practice? requires urgent attention given current component-separated training. These research directions, grounded in the three major findings and integrated framework presented here, represent critical priorities for advancing both theoretical understanding and practical application of 21st-century educational leadership in diverse cultural and institutional contexts.

4. CONCLUSION

This article synthesized evidence from 18 peer-reviewed publications to address a critical gap: how curriculum evaluation, data-driven decision-making, and professional learning communities integrate for 21st-century school improvement. Research questions about integration mechanisms, enabling conditions, and comparative outcomes have been answered through comprehensive integration of empirical evidence and theoretical frameworks grounded in organizational learning, sociocultural learning, and adaptive systems theory.

The synthesis revealed three major findings: Integration enables double-loop learning (Argyris & Schön, 1978)—organizational transformation examining underlying assumptions rather than surface compliance. First, paradigm has shifted from linear compartmentalized evaluation toward circular improvement processes where evaluation findings immediately trigger collaborative action, creating feedback loops validated through RCTs, multilevel SEM, and qualitative studies demonstrating improvements in teaching quality and teacher efficacy. Second, multiple research streams converge on two core mechanisms: organizational responsiveness (continuously adapting based on evidence) and evidence-grounded collective practice (collaborative inquiry using data). Third, successful integration aligns structural conditions (time, procedures), cultural conditions (shared values about evidence), and relational conditions (trust, leadership support), grounded in sociocultural learning theory explaining how collaborative contexts transcend individual cognitive limitations through distributed cognition.

The integrated circular improvement model advances existing frameworks by explicitly specifying integration mechanisms rather than component descriptions. CIPP evaluation provides systematic assessment; data-driven analysis translates findings into priorities; PLCs provide collaborative mechanisms for collective sense-making; adaptive leadership facilitates this cycle; continuous reflection cycles back to evaluation. This differs fundamentally from compartmentalized models where

evaluation disconnects from action, data becomes compliance burden, and PLCs operate without evidence focus.

For school leaders: Prioritize simultaneous attention to structural, cultural, and relational dimensions—establish weekly PLCs analyzing evaluation findings and student data; identify and develop teacher leaders; promote shared improvement vision; invest in professional learning with principal participation; build relationships demonstrating care; and embed practices in formal policies and accountability structures. The nine principal leadership strategies (Qian Haiyan & Walker, 2020)—spanning structural, cultural, and relational dimensions—operationalize this integration. For teachers: Embrace collaborative analysis of evaluation and data, participate in peer observation and mentoring, take leadership roles in PLCs, and shift mindset from viewing evaluation/data as compliance requirements to recognizing them as professional learning resources.

For policymakers: Accountability systems should reward integration quality rather than component compliance. Current policy separately mandates evaluation, data-driven planning, and PLCs, with schools checklist-completing without true integration. Policy should explicitly require integration, provide enabling resources, and assess through observation of collaborative practice. Align curriculum frameworks with teacher evaluation and compensation systems recognizing evidence-grounded collaboration. For teacher education: Pre-service and in-service programs must redesign to integrate data literacy, curriculum evaluation, professional collaboration, and leadership development rather than maintaining siloed courses. Include courses on organizational learning and continuous improvement, collaborative data analysis, curriculum evaluation and practice translation, and PLC leadership. In-service professional development should move toward ongoing, embedded learning within school PLCs where teachers analyze their own data, plan improvements collectively, and reflect with peer and administrative support.

For researchers: Urgent research priorities include cross-cultural validation studies in diverse Asian contexts examining how cultural values and governance structures mediate integration; longitudinal outcome studies tracking implementation through three to five years measuring distal outcomes (student learning, career readiness, graduation rates); barrier and enabler analysis examining contextual factors constraining or facilitating integration; research on technology's role (learning management systems, data dashboards, AI analytics) in supporting or complicating integration; and comparative effectiveness studies in RCTs or quasi-experimental designs.

The urgency is clear: 21st-century educational quality depends on schools' capacity to systematically evaluate curriculum implementation, use evidence to inform teaching decisions, and engage in collective inquiry and collaborative practice.

Compartmentalized approaches prove insufficient. This article demonstrates through comprehensive evidence synthesis that sustainable school improvement requires integration grounded in organizational learning enabling double-loop transformation. Indonesia's Kurikulum Merdeka implementation and similar global educational reforms emphasizing adaptive, evidence-informed, collectively-owned improvement depend precisely on this integrated leadership. School leaders, policymakers, and teacher educators should immediately prioritize integration, providing structural conditions, cultivating cultural values about evidence and collaboration, and building relational foundations of trust and support. The research base is sufficient; the theoretical framework is clear; practical implementation strategies are documented. What remains is commitment to moving from fragmented practice to truly integrated systems where evaluation, data analysis, and professional learning function as mutually reinforcing components of organizational learning and continuous improvement.

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