



Artificial Intelligence in Indonesian Elementary Education: A Systematic Review of Student Motivation, Engagement, and Implementation Challenges

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Abstract: Artificial intelligence (AI) is increasingly used in elementary education to support personalized, multimodal, inclusive, and emotionally responsive learning. However, evidence on its contribution to students' motivation and engagement in Indonesian elementary schools remains limited and fragmented. This systematic literature review synthesized eight Indonesian studies published between January 2020 and April 2026, selected through PRISMA 2020 procedures from Scopus, ERIC, Web of Science, Google Scholar, and relevant national peer-reviewed journals. Using thematic narrative synthesis, the review found that AI-supported learning may enhance students' behavioral, emotional, and cognitive engagement through interactive inquiry, culturally relevant multimedia, emotional learning support, adaptive scaffolding, and inclusive access. AI-based mobile applications, AI-generated animation, AI-driven Canva tools, digital counseling platforms, AI game-based literacy models, and AI-assistive technologies were reported to strengthen participation, enjoyment, learning interest, comfort, comprehension, and accessibility. However, the evidence remains small, methodologically diverse, and inconsistent in measuring motivation and engagement. The findings indicate that AI should be positioned as a pedagogical support rather than a teacher substitute, requiring teacher readiness, ethical governance, inclusive design, infrastructure support, and contextual alignment with Indonesian elementary classrooms.

Keywords: Artificial Intelligence; AI; Elementary Education; Learning Motivation; Student Engagement; Systematic Literature Review.

Introduction

The integration of artificial intelligence (AI) into elementary education has become an increasingly important issue in contemporary educational transformation. AI-supported learning offers opportunities to provide personalized instruction, adaptive feedback, interactive learning resources, and more responsive classroom experiences. In broader digital education ecosystems, technology is no longer viewed only as an administrative tool but also as a pedagogical resource that can support collaboration, participation, and learner-centered instruction (Cimò, 2020; Gobbo et al., 2022; Losa et al., 2021). However, in elementary education, the use of AI requires careful pedagogical consideration because young learners need developmentally appropriate,

meaningful, and socially supported learning experiences rather than merely digitized instruction.

Elementary school represents a critical stage in students' cognitive, emotional, and social development. Children aged approximately 6–12 years require concrete learning experiences, active interaction, social scaffolding, and supportive learning environments to develop understanding and sustain motivation ([Agustyaningrum et al., 2022](#); [Rachma, 2023](#)). Within this developmental stage, learning motivation and engagement are essential because they influence students' participation, curiosity, confidence, persistence, and willingness to complete learning tasks. Motivation also contributes to emotional resilience, self-efficacy, and the formation of lifelong learning habits when classroom experiences are meaningful and responsive to students' needs ([Rahmi et al., 2022](#); [Sugiantiningsih et al., 2023](#)).

AI-supported learning has the potential to strengthen these motivational and engagement dimensions through immediate feedback, adaptive content, multimodal representation, gamified interaction, and personalized learning pathways. In elementary classrooms, these features may help students understand abstract concepts through more concrete and interactive experiences, maintain attention through visual and narrative resources, and participate more actively in differentiated learning activities. Previous studies have also emphasized that AI and digital technologies can support learning and assessment when they are aligned with pedagogical goals, students' developmental characteristics, and meaningful classroom interaction ([Jayawardana, 2023](#); [Oktavianus et al., 2023](#)). Therefore, AI should not be understood merely as a technological innovation, but as a pedagogical support that must be intentionally designed and mediated by teachers.

Despite this potential, AI implementation in elementary education raises several empirical, pedagogical, and ethical concerns. The use of AI among young learners may involve risks related to data privacy, algorithmic bias, excessive dependence on technology, unequal access, and the possible reduction of teachers' pedagogical roles ([Budiyo et al., 2024](#); [Isdayani et al., 2024](#); [Labobar, 2024](#)). These concerns are particularly relevant in Indonesia, where elementary schools vary widely in terms of infrastructure, teacher readiness, digital literacy, and access to educational technology. Without sufficient evidence and ethical guidance, AI adoption may become fragmented, uneven, or driven by technological enthusiasm rather than by clear pedagogical purposes.

Although studies on AI-supported learning in Indonesian elementary education have begun to emerge, the evidence remains limited and scattered across different technologies, learning contexts, research designs, and motivational indicators. Existing studies examine AI-based mobile applications, AI-generated animation, digital counseling platforms, AI-driven visual learning tools, game-based literacy support, AI-assistive technologies, and teacher readiness for AI-supported learning. However, these studies have not been systematically synthesized to explain how AI contributes to elementary students' motivation and engagement, what types of technologies are being used, and what contextual conditions shape their implementation. This gap is important because motivation and engagement in AI-supported learning cannot be understood only from technological features; they must also be examined through pedagogical design, cultural relevance, inclusive access, teacher facilitation, infrastructure readiness, and ethical governance.

Therefore, this study conducts a systematic literature review to synthesize emerging Indonesian evidence on AI-supported learning, motivation, and engagement in elementary education. This review addresses the following research questions: (1) What types of AI-supported learning technologies have been examined in Indonesian elementary education? (2) How do these technologies contribute to elementary students' motivation and engagement? (3) What pedagogical, inclusive, ethical, and implementation conditions shape the use of AI-supported learning in Indonesian elementary schools? By synthesizing eight Indonesian studies, this review contributes to a more nuanced understanding of AI as a pedagogical support for motivation and engagement. The findings are expected to inform teachers, school leaders, curriculum designers, and policymakers in designing AI integration that is pedagogically meaningful, inclusive, culturally relevant, and ethically responsible.

Method

This study employed a systematic literature review design to synthesize empirical and contextual evidence on artificial intelligence-supported learning, motivation, and engagement in Indonesian elementary education. The review followed the PRISMA 2020 framework to ensure transparency in the identification, screening, eligibility assessment, and inclusion of studies (Page et al., 2021). A systematic review approach was considered appropriate because research on AI-supported learning in Indonesian elementary schools remains limited, fragmented, and methodologically diverse.

The literature search was conducted in Scopus, ERIC, Web of Science, Google Scholar, and relevant Indonesian peer-reviewed journals. The search covered studies published between January 2020 and April 2026, with the final search conducted on April 30, 2026. This cut-off date was selected to maintain a realistic search period before the manuscript's publication process. The search strategy combined four main concepts: artificial intelligence, motivation or engagement, elementary education, and the Indonesian context. The following Boolean search string was adapted to the technical requirements of each database:

("artificial intelligence" OR "AI" OR "AI-assisted learning" OR "AI-supported learning" OR "adaptive learning" OR "generative AI" OR "AI-driven" OR "AI-assistive technology") AND ("learning motivation" OR "student motivation" OR "engagement" OR "learning interest" OR "learning comfort" OR "participation" OR "self-regulation") AND ("elementary school" OR "primary school" OR "*madrasah ibtidaiyah*") AND ("Indonesia" OR "Indonesian students" OR "Indonesian elementary education").

The inclusion and exclusion criteria were established before the screening process to ensure consistency in study selection. Studies were included when they focused on Indonesian elementary education, involved AI-supported or intelligent digital learning technologies, and reported motivation- or engagement-related outcomes. Studies were excluded when they focused on non-elementary contexts, did not involve AI-supported learning, or did not report motivation, engagement, learning interest, learning comfort, participation, or related indicators.

Table 1. Inclusion and Exclusion Criteria

Aspect	Inclusion Criteria	Exclusion Criteria
Publication type and period	Peer-reviewed empirical studies published between January 2020 and April 2026	Non-peer-reviewed publications, conceptual papers, opinion papers,

		and studies published outside the search period
Educational context	Studies conducted in Indonesian elementary school, primary school, or <i>madrasah ibtidaiyah</i> contexts	Studies focusing only on early childhood, secondary school, higher education, adult learning, or non-Indonesian contexts
Technology focus	AI-supported, AI-assisted, AI-driven, adaptive, intelligent, generative, or assistive educational technologies	General digital media without clear AI-related features or studies with unclear technological intervention
Outcome focus	Studies reporting learning motivation, engagement, learning interest, participation, learning comfort, happiness, self-regulation, or related motivational indicators	Studies reporting only achievement, technical accuracy, usability, or system performance without motivation- or engagement-related indicators
Relevance to synthesis	Studies providing direct student-level evidence or contextual evidence on teacher readiness and implementation conditions in elementary AI-supported learning	Studies unrelated to elementary AI implementation or lacking sufficient methodological information

The study selection process followed the PRISMA 2020 flow. The initial search identified 43 records from the selected databases and journal sources. After five duplicates were removed, 38 records were screened by title and abstract. Eighteen records were excluded because they did not meet the population, topic, or outcome criteria. The remaining 20 full-text articles were assessed for eligibility. Twelve articles were excluded because they were non-empirical or conceptual articles, focused on unsuitable populations or non-elementary contexts, did not clearly involve AI-supported learning, or did not report motivation- or engagement-related indicators. Finally, eight studies met the inclusion criteria and were included in the final synthesis. The detailed selection process is presented in Figure 1.

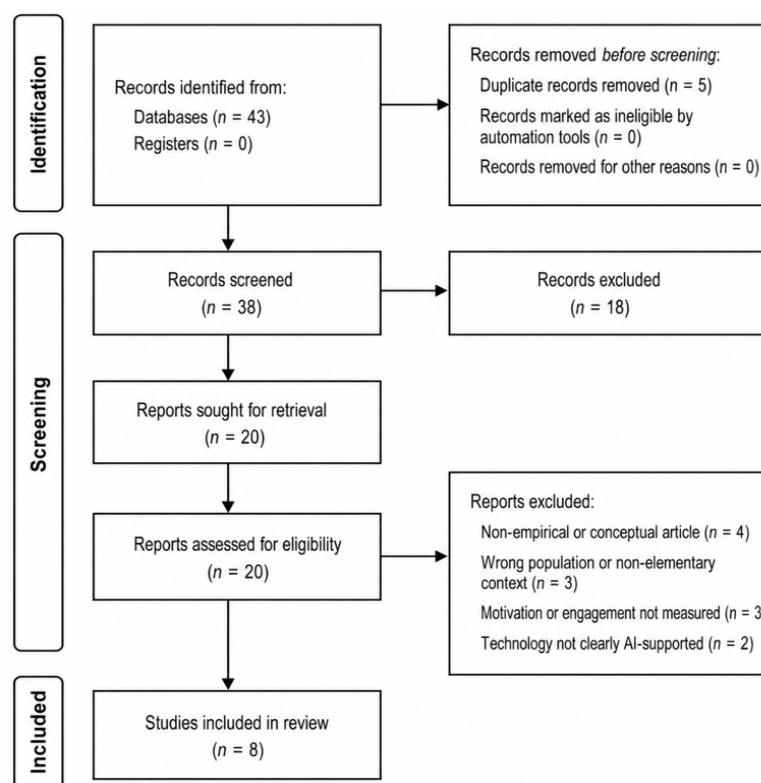


Figure 1. PRISMA 2020 Flow Diagram

The flow diagram shows the identification, screening, eligibility assessment, and inclusion of studies. A total of 43 records were identified, 5 duplicates were removed, 38 records were screened, 20 reports were assessed for eligibility, and 8 studies were included in the final review.

Data were extracted using a structured review matrix. The extracted information included author, year, research design, educational context, participants, AI or technology type, motivation or engagement indicators, key findings, and relevance to the review. The included studies were then categorized into two evidence positions: core evidence and supporting evidence. Core evidence referred to studies that directly involved elementary students and reported motivation- or engagement-related outcomes. Supporting evidence referred to studies that explained teacher readiness, pedagogical capacity, inclusive design, or implementation conditions relevant to AI-supported learning in elementary education.

The methodological quality of the included studies was examined using the Mixed Methods Appraisal Tool (Hong et al., 2018). The appraisal focused on the clarity of research objectives, appropriateness of design, relevance of data collection procedures, coherence of analysis, and credibility of reported findings. Studies were not excluded solely because of methodological limitations; instead, the appraisal was used to interpret the strength and trustworthiness of the evidence during synthesis.

Because the included studies varied in design, intervention type, sample characteristics, and measurement instruments, this review used thematic narrative synthesis rather than meta-analysis. The synthesis was organized into five analytical themes: AI-based inquiry and interactive learning, AI-generated multimedia and cultural storytelling, digital counseling and emotional learning comfort, adaptive and inclusive AI support, and teacher readiness and implementation conditions. This analytical strategy enabled the review to explain how AI-supported learning may contribute to elementary students' motivation and engagement, while also identifying the contextual conditions that shape its implementation in Indonesian elementary education.

Results

1. Characteristics of the Included Studies

The final synthesis included eight Indonesian studies published between 2025 and 2026. The reviewed studies indicate that research on artificial intelligence-supported learning in Indonesian elementary education is still emerging but increasingly diverse in terms of technological intervention, pedagogical design, participant characteristics, and motivational indicators. The studies employed research and development, quasi-experimental, pre-experimental, design and development, qualitative case study, mixed-methods needs analysis, and survey designs. This methodological diversity suggests that AI-supported learning in Indonesian elementary education has not yet developed into a standardized research field, but it has begun to generate important empirical and contextual evidence.

The included studies can be grouped into two categories. The first category consists of core empirical studies that directly examined AI-supported or technology-enhanced interventions involving elementary students. These studies focused on digital counseling, AI-based mobile applications, AI-generated animation, AI-driven Canva learning tools, AI game-based literacy support, and AI-assistive technology for

students with disabilities (Anwar et al., 2026; Gading et al., 2025; Minsih et al., 2026; Nurjanah et al., 2025; Rohani et al., 2026; Setyawan & Purbohadi, 2025). The second category consists of supporting studies that examined teacher needs, inclusive digital design, technological pedagogical readiness, and implementation conditions for AI-supported learning in primary education (Setyawan et al., 2026; Thohir et al., 2025). This distinction is important because not all included studies provide direct evidence of AI's effect on elementary students' motivation; some are better interpreted as contextual evidence explaining the conditions required for effective AI implementation.

Table 2. Summary of Included Studies and Thematic Contributions

Author and Year	Research Focus	AI/Technology Type	Main Contribution to the Review	Evidence Position
Gading et al. (2025)	Learning comfort and happiness among elementary students	Technology-enhanced digital counseling model	Explains how digital counseling supports emotional comfort, happiness, and positive learning experiences	Core evidence
Setyawan and Purbohadi (2025)	Ornamental plant learning in rural elementary schools	AI-based mobile application using image recognition	Shows how AI-based inquiry activities support participation, curiosity, and engagement in science learning	Core evidence
Rohani et al. (2026)	English learning through Indonesian cultural narratives	AI-generated animated storytelling	Shows how culturally familiar AI-generated animation supports attention, enjoyment, and language learning	Core evidence
Nurjanah et al. (2025)	Learning interest among fifth-grade elementary students	AI-driven Canva learning tools	Provides direct evidence that AI-supported visual learning tools can improve elementary students' learning interest through visual, adaptive, and gamified learning activities	Core evidence
Minsih et al. (2026)	Literacy learning for students with specific learning disorder	AI deep learning model	Explains the potential of adaptive and game-based AI for literacy engagement and inclusive learning	Core/supporting evidence
Anwar et al. (2026)	Inclusive education for students with disabilities	AI-assistive technology integrated with Universal Design for Learning	Shows how AI-AT and UDL support engagement and academic outcomes among students with disabilities	Core evidence
Setyawan et al. (2026)	Needs analysis for inclusive elementary learning	Traditional games-based digital application	Explains teacher needs, cultural relevance, inclusive design, and implementation readiness	Supporting evidence
Thohir et al. (2025)	TPACK, motivation, self-regulation, and learning performance	Web-based technology-related learning	Supports the interpretation of teacher readiness and technology-related pedagogical capacity	Supporting evidence

2. Typologies of AI-Supported Learning Technologies

The synthesis identified six main typologies of AI-supported or intelligent digital technologies in Indonesian elementary education. First, AI-based mobile applications were used to support inquiry-oriented science learning through image recognition and immediate feedback. Second, AI-generated multimedia was used to create animated storytelling materials based on Indonesian cultural narratives. Third, technology-enhanced digital counseling was developed to support students' learning comfort and happiness. Fourth, AI-driven Canva learning tools were used to provide visual learning design, adaptive support, personalized feedback, and gamified learning activities. Fifth, AI game-based learning models were used to support literacy engagement among students with specific learning disorders. Sixth, AI-assistive technologies integrated with Universal Design for Learning were applied to support students with disabilities in inclusive classrooms.

These typologies indicate that AI in elementary education should not be understood as a single technological intervention. Instead, AI works through several pedagogical pathways, including immediate feedback, personalization, visual representation, multimodal input, cultural contextualization, emotional support, adaptive scaffolding, and accessibility. The reviewed studies suggest that AI becomes motivationally meaningful when its technological affordances are aligned with students' developmental needs, classroom interaction, and instructional goals.

3. Thematic Synthesis of AI-Supported Motivation and Engagement

The eight studies were synthesized into five thematic findings: interactive inquiry and behavioral engagement, AI-generated multimedia and cultural storytelling, digital counseling and emotional learning comfort, adaptive and inclusive AI support, and teacher readiness and implementation conditions. These themes show that AI-supported learning influences motivation and engagement through different but interconnected mechanisms.

Table 3. Thematic Synthesis of AI-Supported Motivation and Engagement

Theme	Main Evidence	Motivational Dimension	Key Synthesis
AI-based inquiry and interactive learning	Setyawan and Purbohadhi (2025) ; Nurjanah et al. (2025)	Behavioral engagement	AI-supported tools encouraged active participation, curiosity, task involvement, and learning interest through inquiry activities, visual learning, and immediate feedback.
AI-generated multimedia and cultural storytelling	Rohani et al. (2026) ; Nurjanah et al. (2025)	Emotional and cognitive engagement	AI-generated animation and visual learning tools supported attention, enjoyment, cultural familiarity, and comprehension through multimodal learning experiences.
Digital counseling and emotional learning comfort	Gading et al. (2025)	Emotional engagement	Technology-enhanced digital counseling strengthened students' learning comfort, happiness, and positive emotional readiness for learning.

Adaptive inclusive support	and AI	Anwar et al. (2026); Minsih et al. (2026)	Inclusive participation and cognitive engagement	AI-assistive technology, UDL, and game-based adaptive learning supported differentiated access, literacy engagement, and participation among students with disabilities or specific learning disorders.
Teacher readiness and implementation conditions		Setyawan et al. (2026); Thohir et al. (2025)	Contextual support	AI-supported learning requires teacher readiness, pedagogical competence, cultural relevance, infrastructure, and ethical awareness to become meaningful in elementary classrooms.

4. Behavioral Engagement through Interactive and Inquiry-Based AI Learning

The reviewed studies suggest that AI-supported learning may strengthen behavioral engagement when students are actively involved in exploration, inquiry, and interaction with learning objects. In science learning, an AI-based mobile application enabled students to identify ornamental plants through image recognition and connect classroom learning with real-world environmental objects. This type of learning encouraged active participation, curiosity, and task involvement because students were not only receiving information but also interacting with concrete objects and digital feedback (Setyawan & Purbohadi, 2025).

Behavioral engagement was also reflected in AI-driven visual learning and inclusive learning contexts. AI-driven Canva learning tools provided visual, adaptive, and gamified learning activities that encouraged fifth-grade students to participate more actively and show stronger learning interest (Nurjanah et al., 2025). Similarly, AI-assistive technology integrated with Universal Design for Learning helped students with disabilities access learning activities more flexibly and participate more actively in classroom tasks (Anwar et al., 2026). These findings indicate that AI is more likely to enhance behavioral engagement when it creates responsive, accessible, and task-oriented learning experiences.

5. Emotional Engagement through Digital Counseling, Visual Learning, and Cultural Storytelling

The reviewed studies also show that AI-supported and technology-enhanced interventions may contribute to emotional engagement. Digital counseling platforms were reported to support students' learning comfort and happiness, suggesting that educational technology can be used not only to improve academic performance but also to strengthen students' emotional readiness and positive learning experiences (Gading et al., 2025). In elementary education, this emotional dimension is important because young learners' motivation is strongly shaped by whether learning activities feel safe, enjoyable, and personally meaningful.

AI-generated storytelling contributed to emotional engagement by presenting English learning materials through culturally familiar Indonesian narratives. Animated folktales helped students connect new language input with familiar cultural contexts, making learning more attractive and less intimidating (Rohani et al., 2026). In a similar way, AI-driven Canva learning tools supported students' learning interest by combining visual learning design, adaptive support, personalized feedback, and

gamified activities (Nurjanah et al., 2025). These findings suggest that AI-supported tools can strengthen emotional engagement when they create enjoyable, visually meaningful, and culturally relevant learning experiences.

6. Cognitive Engagement through Multimodal and Adaptive Scaffolding

AI-supported learning may also promote cognitive engagement by helping students process information through multiple representations, adaptive feedback, and scaffolded learning pathways. AI-generated animation supported language learning by combining visual, auditory, and narrative elements, which helped young learners maintain attention and understand learning content more effectively (Rohani et al., 2026). AI-based mobile applications also supported cognitive engagement by connecting abstract scientific concepts with concrete objects in students' surroundings, which is developmentally appropriate for elementary learners (Setyawan & Purbohadi, 2025).

AI-driven Canva learning tools further strengthened cognitive engagement by presenting learning materials through visual design, adaptive activities, and gamified tasks that supported students' focus and learning interest (Nurjanah et al., 2025). In inclusive learning contexts, AI game-based models and AI-assistive technologies provided adaptive support for students with diverse learning needs. These tools enabled students to engage with literacy and academic tasks through differentiated pacing, accessible content, and repeated practice (Anwar et al., 2026; Minsih et al., 2026). However, the evidence should be interpreted cautiously because the included studies used different instruments and did not consistently measure motivation through standardized scales. Therefore, the findings indicate promising patterns rather than definitive proof of a uniform causal effect of AI on student motivation.

7. Inclusive AI and Equity-Oriented Learning Support

Inclusive education emerged as one of the strongest themes in the reviewed studies. AI-supported tools showed potential to support students with disabilities and specific learning disorders by offering adaptive, multimodal, and flexible access to learning. The integration of AI-assistive technology with Universal Design for Learning improved engagement and academic outcomes among students with disabilities, indicating that AI can contribute to participation equity when it is designed around learner diversity (Anwar et al., 2026).

AI game-based deep learning models also showed potential for literacy support among elementary students with specific learning disorders. Through adaptive learning pathways, feedback, and game-based interaction, AI-supported literacy tools may reduce learning barriers and sustain students' involvement in literacy activities (Minsih et al., 2026). These findings suggest that AI should not be designed only for general classroom efficiency but also for inclusive learning environments that accommodate different cognitive, sensory, and behavioral needs.

8. Teacher Readiness and Implementation Conditions

The effectiveness of AI-supported learning depends strongly on teacher readiness and pedagogical design. Needs-analysis evidence from inclusive elementary education shows that teachers require digital tools that are culturally relevant, developmentally appropriate, accessible, and aligned with classroom realities (Setyawan et al., 2026). This finding indicates that AI tools may not produce meaningful engagement when

they are introduced without adequate teacher facilitation, instructional planning, and contextual adaptation.

Supporting evidence from pre-service primary teacher education further suggests that technology-related pedagogical knowledge is associated with motivation, self-regulation, and learning performance (Thohir et al., 2025). Although this study does not directly measure elementary students' motivation, it strengthens the argument that teacher capacity is a crucial condition for AI implementation in primary education. Therefore, AI adoption in Indonesian elementary schools should not be limited to providing applications or devices. It also requires teacher training, ethical awareness, infrastructure support, and continuous pedagogical mentoring.

9. Synthesis of Findings

Overall, the eight reviewed studies suggest that AI-supported learning may enhance elementary students' motivation and engagement through five interrelated pathways: interactive inquiry, culturally relevant multimedia, emotional learning support, adaptive scaffolding, and inclusive access. Behavioral engagement is supported when AI encourages students to participate actively in exploration and task completion. Emotional engagement is strengthened when AI-supported tools create enjoyable, comfortable, visually meaningful, and culturally relevant learning experiences. Cognitive engagement is promoted when AI provides feedback, multimodal representation, visual design, and differentiated learning support.

Nevertheless, the evidence base remains limited. The number of eligible studies is still small, the measurement of motivation and engagement is not yet standardized, and two studies function more as contextual or supporting evidence rather than direct student-level intervention evidence. Therefore, AI should be positioned as a promising pedagogical support rather than a guaranteed solution for improving elementary students' motivation. Its effectiveness depends on teacher facilitation, cultural relevance, inclusive design, infrastructure readiness, and ethical governance.

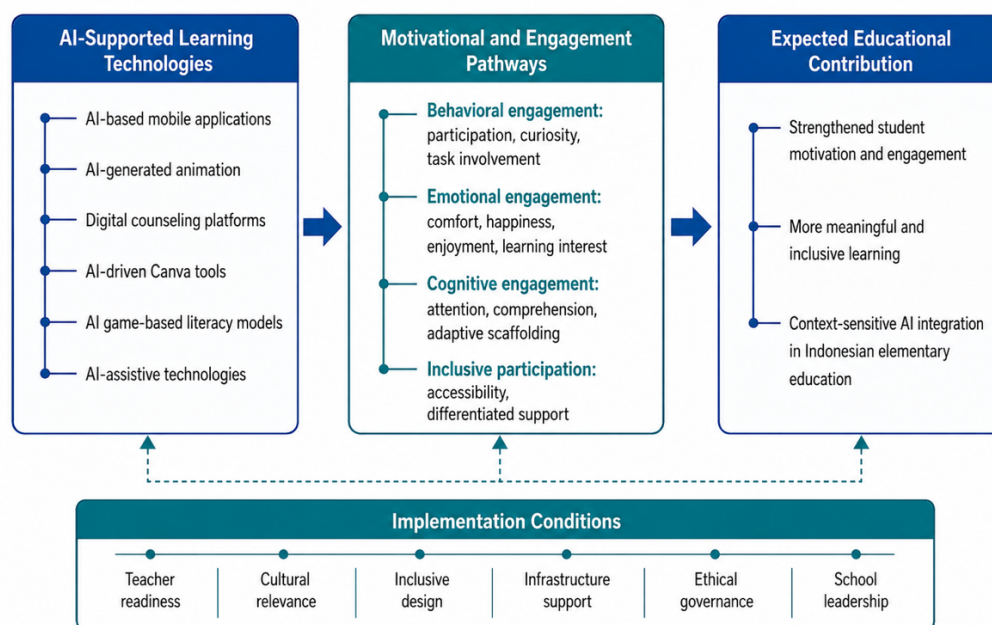


Figure 2. Conceptual Framework of AI-Supported Motivation and Engagement in Indonesian Elementary Education

The framework summarizes how AI-supported learning technologies contribute to students' motivation and engagement through behavioral, emotional, cognitive, and inclusive participation pathways. It also shows that these contributions are shaped by implementation conditions, including teacher readiness, cultural relevance, inclusive design, infrastructure support, ethical governance, and school leadership.

Discussion

The findings of this review suggest that AI-supported learning may enhance elementary students' motivation and engagement when it is embedded within purposeful pedagogical design rather than used merely as a technological add-on. Across the reviewed studies, AI contributed to behavioral, emotional, and cognitive engagement through interactive inquiry, visual representation, adaptive feedback, emotional support, and inclusive access. This pattern is consistent with the view that elementary students require active interaction, concrete learning experiences, and social scaffolding to sustain motivation and meaning-making during learning (Agustyaningrum et al., 2022; Rachma, 2023). AI-based mobile applications, AI-driven Canva tools, digital counseling platforms, and AI-generated animation supported motivation not simply because they introduced new technology, but because they created learning experiences that were more responsive, interactive, and meaningful for young learners (Gading et al., 2025; Nurjanah et al., 2025; Rohani et al., 2026; Setyawan & Purbohadi, 2025).

The motivational contribution of AI appears to be strongest when technology is integrated into active and inquiry-oriented pedagogy. AI-based image recognition enabled students to connect classroom concepts with real-world objects, thereby encouraging curiosity, participation, and task involvement in science learning (Setyawan & Purbohadi, 2025). Similarly, AI-driven Canva learning tools supported students' learning interest through visual, adaptive, and gamified learning activities (Nurjanah et al., 2025). These findings support previous arguments that digital learning ecosystems can strengthen learning when technology is connected to collaboration, interaction, and meaningful pedagogical purposes rather than being used only for efficiency or display (Cimò, 2020; Gobbo et al., 2022; Losa et al., 2021). In this sense, AI functions as a pedagogical mediator that supports exploration, feedback, and learning persistence.

Cultural relevance also emerged as an important condition for effective AI-supported learning in Indonesian elementary education. AI-generated animation based on Indonesian cultural narratives helped students engage with English learning through familiar stories, visual elements, and narrative contexts (Rohani et al., 2026). This suggests that AI-generated content becomes more educationally meaningful when it reflects students' cultural experiences and linguistic realities. In elementary classrooms, culturally relevant AI materials may reduce learning anxiety, increase enjoyment, and strengthen students' emotional connection with learning. This interpretation is consistent with the argument that teachers need to understand students' developmental and cultural characteristics when designing meaningful elementary learning experiences (Rahmi et al., 2022; Sugiantiningsih et al., 2023). Therefore, the effectiveness of AI in Indonesian elementary education depends not only on technological sophistication but also on the extent to which learning materials are locally meaningful, developmentally appropriate, and connected to students' lived experiences.

The findings also highlight the potential of AI to support inclusive and differentiated learning. AI-assistive technology integrated with Universal Design for Learning

supported students with disabilities by providing flexible access, differentiated learning pathways, and adaptive instructional support (Anwar et al., 2026). AI game-based deep learning models also showed potential for supporting literacy engagement among students with specific learning disorders through adaptive tasks, repeated practice, feedback, and game-based interaction (Minsih et al., 2026). These findings align with inclusive education literature emphasizing that school quality is strengthened when learning environments provide participation, accessibility, and self-improvement opportunities for diverse learners (Piccioli, 2022; Piccioli & Reier, 2022). However, inclusive AI should not be treated as a universal solution; its success depends on accessibility, teacher support, appropriate assistive features, and continuous monitoring of students' diverse learning needs.

Teacher readiness remains a decisive factor in the successful implementation of AI-supported learning. The reviewed studies show that AI tools require teacher facilitation, pedagogical planning, and contextual adaptation. Needs-analysis evidence from inclusive elementary education indicates that teachers require digital tools that are culturally relevant, developmentally appropriate, accessible, and aligned with classroom realities (Setyawan et al., 2026). Supporting evidence from pre-service primary teacher education also suggests that technology-related pedagogical knowledge is associated with motivation, self-regulation, and learning performance (Thohir et al., 2025). These findings are consistent with broader literature on AI in learning and assessment, which emphasizes that teachers need pedagogical competence to use AI responsibly and meaningfully in classroom contexts (Oktavianus et al., 2023; Rochmawati et al., 2023). Thus, teachers need not only technical skills but also pedagogical judgment to decide when, why, and how AI should be used in elementary classrooms.

At the institutional level, AI implementation also requires leadership that can balance data-driven decision-making with pedagogical wisdom and humanistic values. Khofi et al. (2026) emphasize that AI can support elementary education management through evidence-based decision-making, but it cannot replace school leaders' interpretive role in considering students' social-emotional development and the specific context of elementary education. This argument strengthens the present review by showing that AI-supported motivation and engagement do not depend only on classroom-level technology use, but also on school leadership, ethical management, and institutional readiness. Therefore, principals and school leaders should function as mediators between AI innovation, teacher capacity, child protection, and equitable learning policy.

The implementation of AI in elementary education is also shaped by infrastructure and equity challenges. Unequal access to devices, unstable internet connectivity, limited technical support, and uneven digital literacy may restrict the scalability of AI-supported learning, particularly in rural or under-resourced schools. Evidence from upper elementary science classrooms in Lebanon also shows that AI integration in K-12 contexts raises urgent concerns about teacher readiness, pedagogical quality, infrastructure, and educational equity (Badawi & Adiyono, 2026). Although this evidence comes from a non-Indonesian context, it is relevant as a comparative reference because Indonesian elementary schools face similar challenges of uneven infrastructure, teacher preparedness, and digital transformation. Therefore, AI implementation in Indonesian elementary education should be accompanied by teacher capacity-building, infrastructure support, inclusive access, and context-sensitive policy design.

Ethical concerns are critical because elementary students are young learners whose data, privacy, and socio-emotional development require strong protection. Prior

studies warn that AI in education may raise issues related to data privacy, algorithmic bias, overdependence on technology, moral formation, and the possible weakening of human interaction in learning (Budiyo et al., 2024; Hakim et al., 2024; Isdayani et al., 2024; Labobar, 2024; Muarifin, 2024). These concerns are especially relevant in elementary education, where learning is not only cognitive but also relational, affective, and moral. Therefore, AI should be positioned as a pedagogical support that strengthens teacher-student interaction, not as a replacement for human guidance, character formation, or contextual judgment.

Theoretically, this review contributes to the literature by showing that AI-supported motivation and engagement in elementary education operate through multiple pathways: behavioral participation, emotional comfort, cognitive scaffolding, and inclusive access. These pathways suggest that motivation in AI-supported learning is not generated by technology alone, but by the interaction between technological affordances, pedagogical design, student characteristics, cultural relevance, and classroom context. This interpretation is strengthened by studies showing that AI and digital technologies can support learning when they are aligned with meaningful assessment, critical and creative thinking, and students' developmental needs (Jayawardana, 2023; Putri et al., 2024). Practically, the findings imply that Indonesian elementary schools should adopt AI gradually and selectively, prioritizing tools that support active learning, cultural relevance, inclusive design, and teacher-mediated interaction (Gading et al., 2025; Nurjanah et al., 2025; Rohani et al., 2026; Setyawan & Purbohadi, 2025).

Overall, the discussion indicates that AI has promising potential to support elementary students' motivation and engagement in Indonesia, but its impact remains contingent on pedagogical, cultural, inclusive, infrastructural, ethical, and leadership conditions. The relatively small number of eligible studies also shows that empirical research on AI-supported learning in Indonesian elementary education remains at an early stage. Therefore, future studies should provide stronger evidence through rigorous research designs, standardized motivation instruments, broader school contexts, and longitudinal analysis of students' motivational, academic, and socio-emotional development.

Limitations and Future Research Directions

This review has several limitations. First, the number of eligible studies remains limited, indicating that empirical research on AI-supported motivation and engagement in Indonesian elementary education is still emerging. Second, the included studies used diverse research designs, intervention types, and measurement instruments, which limited the possibility of conducting a meta-analysis. Third, not all studies provided direct student-level evidence; some were included as contextual evidence because they explained teacher readiness, inclusive design, technological pedagogical capacity, leadership, or implementation conditions relevant to AI-supported learning. Fourth, most reviewed studies were short-term and context-specific, making it difficult to determine the long-term effects of AI on students' motivation, engagement, academic development, and socio-emotional growth.

Future research should employ more rigorous and comparable research designs, including experimental, quasi-experimental, mixed-methods, and longitudinal approaches. Studies should also use standardized and validated instruments to measure learning motivation, behavioral engagement, emotional engagement, cognitive engagement, learning interest, and inclusive participation. In addition, future research needs to involve more diverse Indonesian elementary school contexts, including rural, urban, public, private, and *madrasah ibtidaiyah* settings. Further

studies should examine teacher-AI collaboration, AI-based school leadership, ethical governance, data privacy, infrastructure readiness, and the developmental appropriateness of AI-supported learning for young learners. Comparative studies across countries with similar infrastructure and equity challenges may also help Indonesian researchers identify context-sensitive strategies for responsible AI implementation. Such research will provide stronger evidence for designing AI-supported learning that is pedagogically meaningful, inclusive, culturally relevant, ethically responsible, and institutionally sustainable.

Conclusion

This systematic literature review synthesized eight Indonesian studies on AI-supported learning, motivation, and engagement in elementary education. The findings indicate that AI-supported learning may strengthen students' behavioral, emotional, and cognitive engagement through interactive inquiry, culturally relevant multimedia, emotional learning support, adaptive scaffolding, and inclusive access. AI-based mobile applications, AI-generated animation, AI-driven Canva tools, digital counseling platforms, AI game-based literacy models, and AI-assistive technologies showed potential to support participation, learning interest, enjoyment, comfort, comprehension, and accessibility. However, these motivational benefits are not generated by technology alone; they depend on pedagogical design, teacher facilitation, cultural relevance, inclusive practices, and alignment with students' developmental needs.

The review also shows that empirical evidence on AI-supported motivation and engagement in Indonesian elementary education remains limited and methodologically diverse. Some studies provide direct student-level evidence, while others offer contextual evidence on teacher readiness, technological pedagogical capacity, leadership, and implementation conditions. Therefore, AI should be positioned as a pedagogical support rather than a substitute for teachers or human interaction. For Indonesian elementary schools, responsible AI adoption requires teacher professional development, infrastructure readiness, ethical governance, data privacy protection, inclusive design, and school leadership that balances innovation with child-centered educational values. Future studies should use more rigorous, longitudinal, and context-sensitive designs to examine the sustained effects of AI on students' motivation, engagement, academic development, and socio-emotional growth.

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