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Reimagining Asian Education: Transforming Classrooms with EoT, AI Assistants, and Emerging Digital Innovations

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ABSTRACT

The rapid development of emerging digital technologies is transforming educational practices and creating new opportunities for classroom innovation in Asia. This study examines the role of Education of Things (EoT), artificial intelligence (AI) assistants, and emerging digital innovations in transforming Asian classrooms. A Systematic Literature Review (SLR) was conducted to synthesize relevant scholarly literature published between 2020 and 2025. The review focused on technological applications, educational benefits, implementation conditions, and challenges associated with digital transformation. The findings indicate that EoT and smart learning technologies can strengthen classroom connectivity and interaction, while AI assistants support personalized learning, immediate feedback, and differentiated instruction. Virtual reality, gamification, and other digital innovations can further improve engagement and provide more interactive learning experiences. However, technological transformation remains constrained by unequal infrastructure, limited connectivity, insufficient teacher preparedness, differences in digital and AI literacy, and concerns regarding responsible technology use. The study concludes that sustainable transformation requires alignment between technology, pedagogy, teacher capacity, student readiness, and educational equity. These findings provide insights for educators and policymakers seeking to develop inclusive, responsible, and future-ready learning environments in Asia.

Keywords: *Artificial Intelligence, Asian Education, Digital Innovation, Education of Things, Educational Technology.*

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1. | INTRODUCTION

Rapid advances in digital technology are reshaping educational systems and classroom practices, creating new possibilities for how knowledge is delivered, accessed, and experienced. This transformation is particularly significant in Asian education because educational systems across the region operate within diverse technological, socioeconomic, cultural, and institutional conditions. Artificial intelligence (AI), smart learning environments, connected educational devices, immersive technologies, gamification, and generative AI are increasingly incorporated into educational practices, shifting technology from a supplementary instructional resource toward an integrated component of learning environments (Chen et al., 2020; Zhai et al., 2021; Wang et al., 2024). The development of AI in education has also progressed from technology-directed applications toward AI-supported and AI-empowered learning paradigms that place greater emphasis on learner interaction and participation (Ouyang & Jiao, 2021).

One emerging dimension of this transformation is the development of interconnected learning environments, including Education of Things (EoT), in which physical classroom resources, digital platforms, teachers, and learners can interact through connected technologies. EoT extends the application of the Internet of Things into educational environments and provides opportunities for connected and smart learning through the integration of physical and digital resources (Nehru & Chakraborty, 2020). Smart learning environments similarly emphasize connectivity, personalization, flexibility, and learner interaction, suggesting that digital transformation is increasingly concerned with creating adaptive learning ecosystems rather than simply introducing individual technological tools (Tabuenca et al., 2021).

Smart learning environments similarly emphasize connectivity, personalization, flexibility, and learner interaction, suggesting that digital transformation is increasingly concerned with creating adaptive learning ecosystems rather than simply introducing individual technological tools (Tabuenca et al., 2021). At the same time, digital technologies can support self-regulated learning by enabling students to access learning resources flexibly, monitor learning activities, and exercise greater autonomy in managing their learning processes (Gambo & Shakir, 2021). These developments indicate that educational transformation involves not only technological connectivity but also changes in learner participation and instructional practices.

The emergence of generative AI and ChatGPT has accelerated this transformation. ChatGPT has been investigated for learning support, academic tasks, feedback, content generation, and interaction with students, with systematic evidence indicating both educational opportunities and limitations (Montenegro-Rueda et al., 2023; Albadarin et al., 2024). Recent systematic reviews have further demonstrated that ChatGPT research in higher education encompasses diverse applications, adoption issues, limitations, and research challenges (Baig & Yadegaridehkordi, 2024). Its influence on student engagement, motivation, and participation has also become an important area of

investigation (Lo et al., 2024). Furthermore, ChatGPT and generative AI may contribute to personalized learning and learner empowerment by providing students with accessible assistance and opportunities for greater autonomy (Mohebi, 2024). Evidence from a recent systematic review and meta-analysis also suggests that generative AI can affect university students' learning outcomes, although its educational effects remain dependent on the characteristics of implementation and learning contexts (Chen & Cheung, 2025).

The expansion of generative AI also reinforces the importance of AI literacy. Effective educational use requires learners and educators to understand AI capabilities, limitations, evaluation, and responsible use. Research on AI literacy has emphasized the development of competencies necessary for meaningful participation in AI-supported environments (Yim, 2024; Cebreiro & Barro, 2023). This issue extends beyond students to educators, because teachers require appropriate knowledge, pedagogical strategies, and readiness to integrate AI into learning activities. Systematic research on teaching AI in K-12 education highlights the importance of instructional design and experiential learning in developing meaningful AI education (Liu & Zhong, 2024).

Beyond AI, immersive and interactive technologies provide additional mechanisms for transforming classrooms. Augmented reality (AR) can support interactive and experiential learning while requiring attention to usability and user experience (Law & Heintz, 2021). Similarly, AR applications in programming education demonstrate opportunities for interactive learning and the development of computational thinking (Theodoropoulos & Lepouras, 2021). Virtual reality can provide immersive environments that support experiential and personalized learning (Marougkas et al., 2024; Won et al., 2023). Gamification can further strengthen engagement, motivation, and participation when game elements are appropriately aligned with pedagogical objectives (Krath et al., 2021; Zainuddin et al., 2020). Research on digital technology in primary education likewise demonstrates that technology integration can influence classroom learning practices and learning outcomes, while its effectiveness remains dependent on educational and contextual conditions (Gunnars, 2021).

Despite these developments, technological adoption does not automatically guarantee equitable or meaningful educational transformation. Differences in infrastructure, connectivity, teacher preparedness, digital and AI literacy, usability, and access may constrain the benefits of emerging technologies. Existing literature also remains fragmented across AI, ChatGPT, smart learning, immersive technologies, gamification, and digital education, making it necessary to synthesize these developments within an integrated educational transformation perspective (Celik et al., 2022; Mustafa et al., 2024). Therefore, this study aims to systematically synthesize literature on Education of Things, AI assistants and generative AI, immersive and interactive technologies, gamification, and related digital innovations, with particular attention to their contributions to personalization, engagement, learner autonomy, and

educational transformation, as well as the infrastructure, teacher-readiness, literacy, equity, and responsible-use challenges affecting their implementation in Asian education.

2. | RESEARCH METHOD

This study employed a Systematic Literature Review (SLR) to identify, evaluate, and synthesize scholarly research concerning the transformation of education through Education of Things (EoT), artificial intelligence (AI) assistants and generative AI, smart learning environments, immersive and interactive technologies, gamification, and related digital innovations. The SLR approach was selected because it provides a structured procedure for organizing and comparing findings across existing studies and is particularly appropriate for synthesizing rapidly developing research areas such as AI, ChatGPT, digital learning, and emerging educational technologies (Albadarin et al., 2024; Baig & Yadegaridehkordi, 2024; Yusuf et al., 2024). The review focused on scholarly literature published between 2020 and 2025 in order to capture recent developments in educational technology and the increasing integration of intelligent, connected, immersive, and generative technologies into learning environments.

The literature search was conducted using Google Scholar and other academic databases identified within the research process. Search terms were developed according to the objectives and scope of the study and included combinations of "Education of Things," "EoT in education," "AI in education," "AI assistants," "ChatGPT in education," "generative AI in education," "AI literacy," "smart learning environments," "self-regulated learning," "augmented reality in education," "virtual reality in education," "gamification in education," "digital technology in primary education," and "Asian education." Boolean combinations were used to broaden the identification of potentially relevant studies while maintaining alignment with the research focus. The search strategy was informed by the themes identified across systematic reviews concerning ChatGPT, generative AI, AI literacy, immersive technologies, gamification, and digital learning (Lo et al., 2024; Yim, 2024; Cebreiro & Barro, 2023; Law & Heintz, 2021; Krath et al., 2021).

The selection process consisted of identification, screening, eligibility assessment, and final inclusion. Studies were considered eligible when they were published between 2020 and 2025, appeared in academic journals or other credible scholarly publications, addressed AI, generative AI, ChatGPT, EoT, smart learning, immersive or interactive technologies, gamification, digital technology, or related educational innovations, and provided findings relevant to educational practice, learning processes, learner engagement, learning outcomes, teacher readiness, AI literacy, or technology integration. Studies unrelated to education, lacking substantive discussion of emerging or digital technologies, or failing to address the objectives of the review were excluded. The selected literature was examined through title and abstract screening, followed by assessment of the relevance of available full-text content. This procedure follows the general systematic approach reflected in existing reviews of AI, ChatGPT, AI literacy,

and digital educational technologies (Wang et al., 2024; Mustafa et al., 2024; Liu & Zhong, 2024). The overall study identification and selection procedure is illustrated in Figure 1.

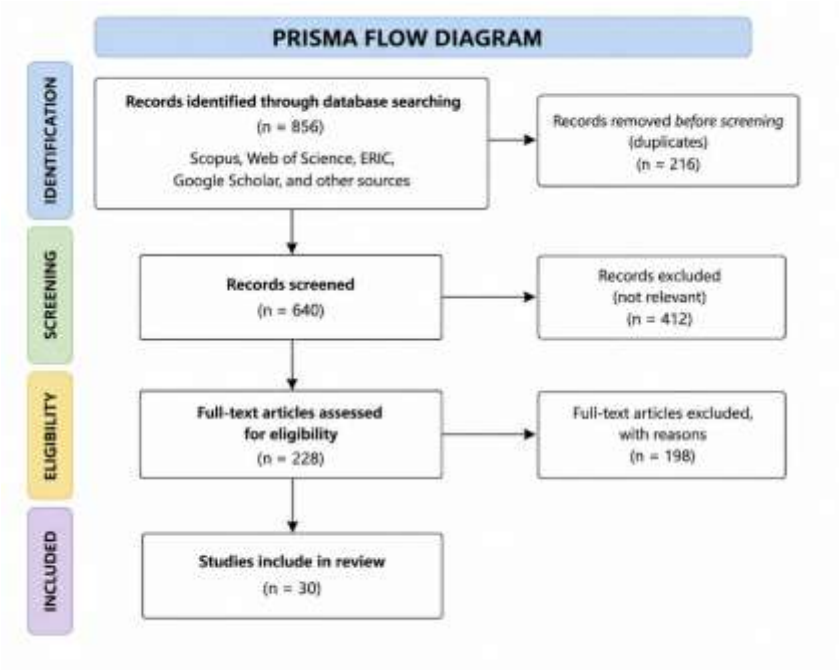
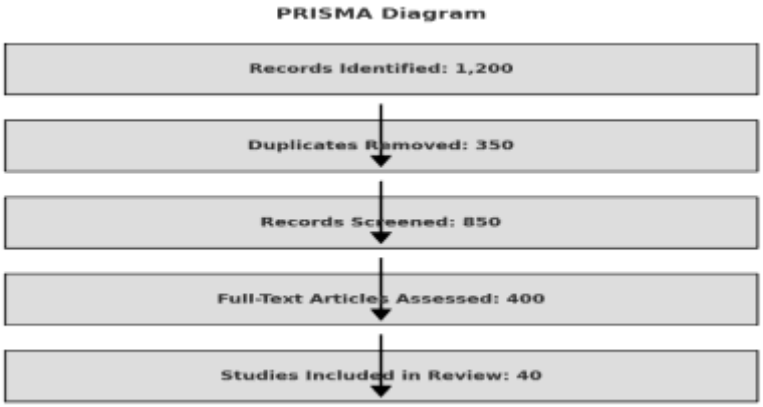


Figure 1. PRISMA-based literature identification and selection process

Data were extracted according to the technological focus of each study, educational application, learning contribution, implementation conditions, and reported limitations or challenges. Particular attention was given to personalization, student engagement, motivation, learner autonomy, learning outcomes, teacher readiness, AI and digital literacy, usability, infrastructure, accessibility, and responsible technology use. The selected literature was then analyzed through thematic synthesis to identify recurring relationships among technology, pedagogy, learner participation, teacher capacity, and educational equity. The synthesis was organized around four interconnected dimensions: technological transformation of learning environments; personalization, engagement, and learner autonomy; teacher and learner readiness; and equity, access, and responsible implementation. This thematic approach enabled the study to integrate findings across different technological domains and develop a broader understanding of the conditions required for meaningful and sustainable transformation of Asian classrooms.



3. | RESULTS AND DISCUSSION

The systematic literature review demonstrates that the transformation of Asian classrooms is increasingly shaped by the interaction between connected technologies, artificial intelligence, generative AI, immersive learning, gamification, and digitally supported learner autonomy. Rather than functioning as isolated tools, these technologies increasingly form interconnected learning environments in which technology, pedagogy, teachers, and students jointly influence educational experiences. Previous research has established that AI has expanded from conventional computer-assisted instruction toward adaptive, intelligent, and learner-centered educational applications (Chen et al., 2020; Zhai et al., 2021; Ouyang & Jiao, 2021). Smart learning environments similarly provide affordances for interaction, personalization, flexible access, and learner-centered activities (Tabuenca et al., 2021). This development is consistent with the broader mapping of generative AI research, which identifies educational applications, adoption, performance, and ethical implications as major themes in the rapidly expanding literature (Yusuf et al., 2024).

One important finding concerns the growing role of connected and smart learning environments. Education of Things (EoT) represents an extension of Internet of Things applications into education, enabling physical learning resources, digital systems, educators, and learners to become more interconnected. Nehru and Chakraborty (2020) conceptualize EoT as an IoT-based approach for smart learning, highlighting the potential of connected technologies to support educational processes and future learning environments. This perspective is consistent with research on smart learning environments, which identifies technological affordances for interaction, personalization, access to learning resources, and flexible learning activities (Tabuenca et al., 2021). These findings suggest that connected educational devices can contribute to classroom transformation when they are integrated with meaningful pedagogical strategies rather than used merely for technological demonstration.

A particularly significant finding concerns the expansion of AI assistants and ChatGPT as learning-support technologies. Systematic evidence shows that ChatGPT has been applied to learning assistance, writing, feedback, academic tasks, content

generation, and interaction with learners (Montenegro-Rueda et al., 2023; Albadarin et al., 2024). The empirical literature reviewed by Albadarin et al. indicates that ChatGPT is used across different educational settings, while the emerging higher-education literature emphasizes both applications and unresolved challenges surrounding adoption and implementation. Baig and Yadegaridehkordi (2024) similarly demonstrate that ChatGPT research in higher education encompasses multiple applications while identifying limitations and research challenges that require further investigation. Therefore, the findings do not support viewing ChatGPT simply as an automated replacement for conventional instruction; rather, it functions most productively as an additional learning resource whose value depends on pedagogical integration.

The review further indicates that the educational contribution of generative AI is closely associated with engagement, personalization, and learner autonomy. Lo et al. (2024) identify student engagement as an important dimension of ChatGPT-supported learning, including students' motivation and participation in learning activities. Mohebi (2024) likewise highlights the potential of ChatGPT to empower learners by supporting personalized learning and greater autonomy. These findings correspond with research on smart learning environments, where technology-supported flexibility and access can facilitate self-regulated learning (Gambo & Shakir, 2021). Consequently, AI-supported education may contribute to a shift from teacher-directed learning toward environments in which students can obtain assistance, explore content, and manage aspects of their own learning. Nevertheless, learner autonomy should not be interpreted as technological independence; students still require guidance to evaluate information, formulate appropriate questions, and use AI outputs critically.

Evidence concerning learning outcomes also provides support for the potential educational value of generative AI, although the effects are not uniform. Chen and Cheung (2025), through a systematic review and meta-analysis of 57 studies and 97 effect estimates, found positive effects of generative AI on university students' learning outcomes, particularly language skills, academic achievement, affective-motivational outcomes, and higher-order thinking, while no statistically significant effect was found for metacognition. This distinction is important because it suggests that AI may strengthen observable learning performance without automatically developing students' capacity for independent metacognitive regulation. Similarly, Deng et al. (2025) emphasize that the effects of ChatGPT-supported learning depend on intervention characteristics and educational contexts. Thus, the effectiveness of generative AI is better understood as conditional on learning design, task structure, teacher guidance, duration, and student characteristics rather than as an inherent property of the technology itself.

Another major result is the increasing importance of AI literacy. As AI becomes embedded in educational environments, students need competencies that extend beyond general digital literacy. They need to understand AI capabilities, limitations, generated outputs, ethical implications, and appropriate patterns of use. Yim (2024) argues for an

intelligence-based AI literacy framework that connects AI knowledge with educational competencies, while Cebreiro and Barro (2023) demonstrate the diversity of approaches used to develop AI literacy in K-12 education. The issue is therefore relevant across educational levels, from primary education to higher education. AI literacy also becomes particularly important because generative AI can produce information that appears authoritative but requires human evaluation. The systematic review of AI literacy scales by Lintner (2024) further indicates that measurement and conceptualization of AI literacy remain developing areas, reinforcing the need for context-sensitive approaches.

Teacher capacity constitutes another critical condition for successful digital transformation. AI literacy cannot be separated from teacher readiness because educators determine how technologies are incorporated into instructional activities, assessment, and classroom interaction. Liu and Zhong (2024) show that K-12 AI education increasingly emphasizes experiential learning for complex AI-related content and identifies instructional design as an area requiring further development. This finding complements Celik et al. (2022), who emphasize both the opportunities and challenges AI creates for teachers. Accordingly, teacher professional development should extend beyond operational training and include pedagogical integration, critical evaluation of AI-generated content, assessment design, ethical considerations, and classroom management. The transformation of teachers' roles from information transmitters toward facilitators, designers, evaluators, and supervisors is therefore an important consequence of educational digitalization.

The findings also demonstrate that AI is only one component of broader educational innovation. Augmented reality provides opportunities for interactive and experiential learning, but usability and user experience remain important determinants of its educational value (Law & Heintz, 2021). In programming education, AR can facilitate interactive learning and support computational thinking by connecting abstract concepts with more tangible learning experiences (Theodoropoulos & Lepouras, 2021). Similarly, immersive virtual reality can provide learning environments that are difficult to reproduce through conventional classroom instruction. Research has identified opportunities for personalized and effective immersive learning (Marougkas et al., 2024) and diverse approaches to learning with immersive VR (Won et al., 2023). These technologies can therefore strengthen active participation, but equipment costs, infrastructure requirements, teacher preparation, and technical complexity may restrict their accessibility, particularly in under-resourced educational contexts.

Gamification represents another important mechanism through which digital innovation can influence classroom participation. Zainuddin et al. (2020) identify positive relationships between gamification and learning, instruction, engagement, motivation, and achievement, while Krath et al. (2021) demonstrate the importance of theoretical foundations in understanding gamification, serious games, and game-based

learning. These findings indicate that game elements such as challenges, feedback, rewards, and competition can make learning activities more interactive. However, gamification should remain connected to explicit learning objectives. Increased participation alone does not necessarily guarantee meaningful learning, particularly when entertainment becomes more prominent than cognitive engagement. Therefore, gamification is most appropriately understood as a pedagogical mechanism rather than simply a technological feature.

The review additionally identifies digital learning and connected environments as important mechanisms for supporting educational continuity and learner autonomy. The rapid expansion of online and blended learning demonstrated that digital platforms can maintain educational activities under changing conditions, although technology-mediated delivery does not automatically produce equivalent learning outcomes (Koh & Daniel, 2022). Mobile learning research similarly shows that technological, learner-related, and institutional factors influence successful implementation (Sophonhiranrak, 2021). At the primary-school level, large-scale evidence on digital technology demonstrates the importance of understanding how digital tools interact with classroom learning processes rather than assuming that technology itself determines outcomes (Gunnars, 2021). Thus, the value of EoT, smart learning, mobile learning, and digital platforms depends on their integration with appropriate pedagogical practices.

Finally, the synthesis identifies equity, infrastructure, responsible use, and ethical governance as major challenges. Digital transformation requires reliable connectivity, suitable devices, electricity, technical support, and institutional capacity. Unequal access can therefore reproduce or intensify educational inequalities rather than eliminate them. AI and generative AI additionally introduce concerns related to privacy, reliability, bias, academic integrity, transparency, and responsible use. Yusuf et al. (2024) identify ethical implications and adoption as major themes in generative AI research, while Mustafa et al. (2024) call for broader research agendas that move beyond isolated AI applications. The findings consequently support an integrated model in which infrastructure provides the technological foundation, pedagogy determines how technologies are translated into learning activities, teacher and learner competencies determine effective use, and equity and responsible governance determine whether transformation is sustainable.

This interpretation reinforces the central argument of the original manuscript that meaningful transformation of Asian classrooms cannot be achieved through technological adoption alone but requires alignment among technology, pedagogy, human capacity, educational objectives, and equitable access. Based on the thematic synthesis, the transformation of classrooms can be understood as an interconnected process in which technological innovation supports pedagogical transformation and ultimately contributes to student outcomes. However, these relationships are shaped by human capacity, equitable access, and responsible implementation. The integrated framework developed from the synthesis is presented in Figure 2.

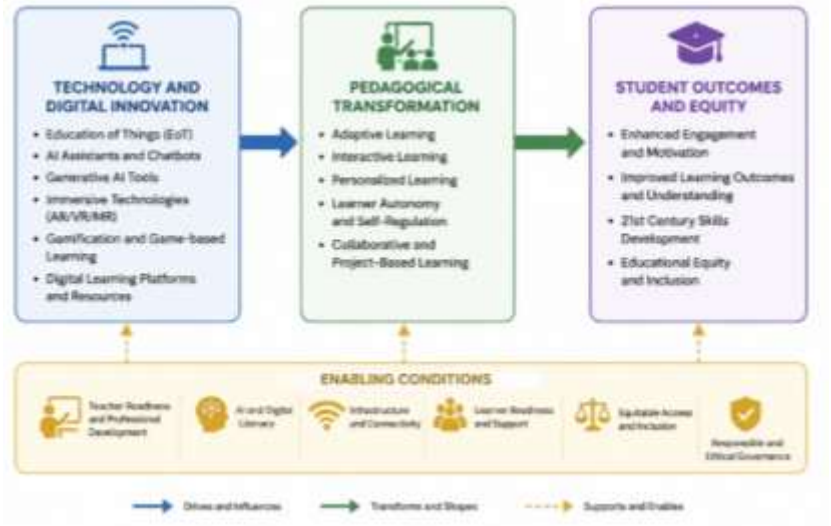


Figure 2. Integrated framework for transforming classrooms through emerging digital technologies

4. | CONCLUSION

This study concludes that emerging digital technologies have substantial potential to transform Asian classrooms by creating learning environments that are more connected, personalized, interactive, flexible, and learner-centered. The synthesis demonstrates that Education of Things, artificial intelligence assistants, generative AI, smart learning environments, immersive technologies, augmented reality, virtual reality, gamification, and digital learning platforms can contribute to student engagement, personalized learning, learner autonomy, learning outcomes, and the development of digital and AI competencies. However, these benefits do not arise automatically from technological adoption. Their educational value depends on the quality of pedagogical integration, learning design, teacher guidance, learner readiness, and the alignment between technological capabilities and educational objectives.

The findings further indicate that teacher readiness and AI literacy are essential for ensuring that emerging technologies are used critically, effectively, and responsibly. Students likewise require competencies that enable them to evaluate digital and AI-generated information and regulate their own learning. At the institutional level, unequal infrastructure, limited connectivity, differences in technological access, and insufficient professional development remain significant barriers to sustainable transformation. Ethical concerns involving privacy, reliability, bias, academic integrity, and responsible technology use also require appropriate institutional governance.

Therefore, sustainable digital transformation in Asian education requires an integrated approach that combines technological infrastructure, pedagogical innovation, teacher and learner capacity, equitable access, and responsible governance. Future educational development should prioritize inclusive technology integration rather than technology adoption alone, while future research should further examine

long-term learning outcomes and the effectiveness of integrated digital transformation models across diverse Asian educational contexts.

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Conflict of Interest Statement

The authors declare that there is no conflict of interest.

Ethical Approval and Originality Statement

Ethical approval was obtained for this study. The manuscript represents original work and has not been previously published, nor is it under consideration by another journal.

Data Disclosure Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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