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A Vietnamese Case Study of Artificial Intelligence in K-12 Education

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ABSTRACT: Artificial intelligence (AI) in K-12 education has the potential to alter learning experiences through individualized instruction, adaptive learning systems, and intelligent tutoring systems. It uses AI's data analysis skills to deliver personalized learning routes suited to each student's needs. AI technologies can evaluate student progress in real-time, provide timely feedback, and find areas for growth. Furthermore, AI-powered educational systems may assist instructors by automating administrative work, allowing for more emphasis on student connection and instructional innovation. However, issues like data protection, equitable access to technology, and the requirement for teacher and student training in AI integration must be solved before AI can fully realize its promise in K-12 education. This study demonstrates a Vietnamese Xschool employing AI for grades 1, 2, 3, and 7. Notably, the case study highlights the key challenges faced in AI implementation in practice and provides practical implications for the effectiveness of AI implementation for primary and secondary schools.

KEYWORDS: AI; Xschool; Challenges

1. Introduction

Artificial intelligence encompasses a wide range of systems that allow machines to replicate complex human abilities. This technology enables individuals to utilize data and analytics to automate routine tasks or improve experiences. With the strong development of technology today, artificial intelligence (AI) has become an inevitable trend, affecting all aspects of society, the economy, and daily life. To help teachers improve productivity and work efficiency, foster innovation and creativity, and at the same time help students develop critical thinking skills, problem-solving skills, improve programming and technology skills, enhance innovation and creativity, strengthen personalized learning, and contribute to solving global challenges, all teachers and students need to understand and apply AI. AI not only helps students in the process of grasping knowledge and practicing skills more effectively and creatively but also provides them with digital capabilities to be ready to master and face future challenges and opportunities.

AI implementation in Vietnamese K-12 education is gradually advancing, with efforts focusing on integrating AI tools to enhance teaching and learning experiences. Vietnam, like many other countries, is recognizing the potential of AI in transforming education, particularly in improving personalized learning, administrative efficiency, and supporting teachers. Therefore, From the 2022-2023 school year, at a Vietnamese private primary- secondary school, called Xschool, students have been introduced to and learned about ChatGPT. Then, at the beginning of the 2023-2024 school year, all teachers in the school participated in an internal workshop training titled "Applying AI in Teaching" in August 2023. From April 22 until the end of the school year, students in grades 1,2,3 and 7 were introduced to a series of 10 AI lessons as part of their regular curriculum in the Computer Science subject, and many encouraging results were achieved. This study will demonstrate the achievements and challenges faced in AI implementation of a Vietnamese Xschool.

2. Literature Review

2.1. Definitions of AI.

There are various definitions of AI. AI is described as a technology that "functions appropriately and with foresight in its environment" [1]. Moreover, the High-Level Expert Group on Artificial Intelligence (AI HLEG) of the European Commission has proposed a comparable definition: "Systems that demonstrate intelligent behavior through analysis of their surroundings and autonomous action-taking to accomplish defined objectives" [2]. Later, Nick Bostrom, the director of the Oxford Institute for Internet Governance, suggests that AI encompasses anything that impresses us at a particular moment. Once we are no longer impressed, we just refer to it as software [3]. Importantly, the philosopher Daniel Dennett takes it a step further, proposing that AI should not be modeled after humans at all. Instead, he views these as entirely new kinds of entities, akin to oracles: beings that can make predictions but lack personality, conscience, or emotions like humans do.

Especially, AI in education, as noted by Chassignol et al., has been integrated into administration, instruction or teaching, and learning [4]. These areas, highlighted by Chassignol et al. as the basis for analyzing and comprehending AI in education, will define the scope of this study.

2.2. The roles of AI in education.

First of all, AI applications in education, in various forms and serving different functions, have significantly impacted administrative and management tasks. They have enabled instructors or teachers to perform administrative duties more efficiently, such as grading and giving feedback to students. AI-based programs have integrated features that offer grading guides, simplifying the evaluation of student work and providing feedback [5]. Similarly, AI has also streamlined administrative tasks, enhancing teacher or instructor efficiency and effectiveness helping instructors manage tasks like grading and feedback [6]. AI has greatly diminished the amount of paperwork and workload for educators, particularly in performing administrative tasks. This allows them to concentrate more on their primary responsibilities: teaching, delivering content, and aligning with institutional or national curriculum requirements [7].

Second, AI applications also have great impacts on instruction. Pokrivcakova highlights the transformative impact of AI in education. By harnessing technology-based adaptive systems, AI has significantly enhanced the quality and effectiveness of instruction. These systems have the capability to tailor content to individual learners' needs, thus optimizing the overall learning experience [5]. Moreover, AI plays a crucial role in ensuring the efficient distribution of course content, spanning from curriculum development to the delivery of instructions, particularly in online and web-based learning environments [5]. Mikropoulos and Natsis contend that the progress and implementation of AI, particularly its incorporation into online and web-based educational platforms, have led to notable enhancements in instructional approaches. This is attributed to AI enabling the development and use of more impactful pedagogical tools for such platforms [8]. Remarkably, Roll and Wylie emphasize the influence of AI on education, particularly its role in improving the effectiveness and efficiency of instruction. They point out that AI, especially in tutoring and instructional systems, is designed to tackle challenges commonly linked to one-on-one teacher-student interactions, thereby enhancing the quality of educators' work [9].

Third, the previous studies also point out the significant effects of AI in learning. AI enables the tracking of learning progress, covering both knowledge and comprehension. It utilizes the acquired insights to enhance the system's capability to customize content according to each student's needs and abilities. This personalized approach motivates students and leverages their individual strengths to enhance learning and retention. [5, 6]. Similarly, it is discussed how AI algorithms can create personalized student learning plans based on individual needs, interests, and abilities. This customization can improve learning outcomes and engagement by aligning content with students' interests and increasing their motivation [10].

2.3. Challenges of AI in education.

Beyond the sound effects of AI in administration, instruction, and learning, there are still several challenges in AI implementation faced by teachers and students. A significant worry is that students might use AI tools to cheat on assessments or avoid the learning process. For example, the findings of [11] point out that AI can produce papers or finish student assignments, which diminishes the educational value of these tasks. More than that, according to [12], unequal access to technology and the Internet among students can lead to disparities in their ability to utilize AI-powered tools and resources. This digital divide may further worsen existing inequalities in educational opportunities and outcomes. One of the primary difficulties often observed is the restricted technical capability of AI. For instance, AI may not effectively evaluate visual elements like graphics alongside text. According to [13], an AI-driven system needed help to gauge the complexity of texts containing images. Another significant challenge identified was the limited dependability of AI algorithms. Thus, enhancements are necessary for automated writing evaluation technologies employing AI algorithms to ensure dependable assessments for educators [14]. The inefficiency of AI systems in assessment and evaluation primarily concerns validity rather than reliability. AI-based scoring occasionally results in inaccurate performance assessments [15]. In addition,integrating AI into education faces two additional challenges: teachers' insufficient technological knowledge [16] and inadequate technical infrastructure in schools [17].

2.4. The future trends of AI in education.

The future of AI in education holds great promise for transforming how students learn and how teachers instruct. AI is poised to revolutionize learning experiences by tailoring them to individual students' needs and pace, ultimately leading to improved engagement and comprehension. Intelligent tutoring systems and virtual assistants are set to provide valuable real-time feedback and support, thereby enhancing accessibility and inclusivity in education.

Additionally, AI has the potential to significantly alleviate teachers' workload by automating administrative tasks, allowing them to prioritize teaching. As AI continues to progress, it will undoubtedly contribute to the development of more efficient, personalized, and equitable educational environments. Here are some potential future trends for artificial intelligence in education: (1) High-quality online lecture videos; (2) Utilization of various online learning platforms and applications; (3) Gamification fostering experiential learning; (4) Enhancement of teaching methods through artificial intelligence; (5) Increased acceptance in workplaces; (6) Learning experiences comparable to traditional classroom settings; (7) Unlikely to replace traditional learning; (8) Growing popularity of mixed-mode courses; and (9) Significant potential for augmenting traditional in-person courses [18].

3. Methodology

3.1. Research design.

This study employs a qualitative single-case study design to explore the implementation of artificial intelligence in K-12 education at Xschool, a private primary-secondary school in Vietnam. The case study approach was selected due to its appropriateness for examining contemporary phenomena in real-life contexts, particularly when the boundaries between the phenomenon and the context are not clearly evident [19]. This design allows for an in-depth, multi-faceted exploration of complex issues in their natural settings, making it ideally suited for investigating the nuanced processes, challenges, and outcomes associated with integrating AI into teaching and learning environments.

The single-case study design is justified on the grounds that Xschool represents a critical, unique, and revelatory case [19]. It is critical because Vietnam's educational system is at an early stage of AI adoption, and understanding the experiences of pioneering institutions provides foundational knowledge for future large-scale implementations. It is unique due to the school's early adoption of AI instruction across multiple grade levels (grades 1,2,3 and 7) beginning in the 2022-2023 academic year, well before national policy mandates. Furthermore, it is revelatory as it offers researchers an unprecedented opportunity to observe and analyze a phenomenon previously inaccessible to empirical investigation—namely, the systematic integration of AI literacy into the formal curriculum of young learners in the Vietnamese context.

The case study method, as articulated by Yin [19], is particularly advantageous when the research seeks to answer "how" and "why" questions. In this study, the central questions are: (1) How is AI being implemented across different grade levels at Xschool? (2) Why do particular challenges emerge during the implementation process? and (3) How do teachers and students experience and respond to these challenges? These interrogative forms necessitate a methodology capable of capturing processual dynamics, contextual influences, and participant perspectives, all hallmarks of rigorous case study research.

3.2. Case selection and description.

The selection of Xschool as the case site was purposeful rather than random, following the logic of information-oriented selection. Xschool was chosen because it satisfies several criteria essential to the research objectives: (1) demonstrated commitment to AI integration through institutional policy and resource allocation; (2) implementation spanning both primary and secondary levels; (3) documented teacher training initiatives; (4) development of original AI curriculum materials; and (5) willingness to provide researchers with comprehensive access to documentation, personnel, and classroom observations.

Xschool is a private educational institution located in Hanoi, Vietnam, serving students from grade 1 through grade 12. The school enrolls approximately 1,200 students and employs 85 teaching staff. The school's technology infrastructure includes computer laboratories, high-speed internet access, and device-to-student ratios that are substantially above national averages. Xschool's decision to integrate AI into the Computer Science curriculum beginning in the 2022-2023 school year positioned it as an early adopter within the Vietnamese educational landscape. The implementation initially focused on ChatGPT familiarization and subsequently expanded to include a structured 10-lesson AI series across grades 1, 2, 3, and 7 during the 2023-2024 academic year.

3.3. Data collection methods.

Consistent with the case study tradition of methodological pluralism, this research employed multiple data collection strategies to capture the complexity of AI implementation from diverse vantage points. Triangulation across data sources, investigators, and methods was systematically pursued to enhance the credibility and trustworthiness of findings [19].

3.3.1. Document analysis.

Comprehensive document analysis constituted the foundational layer of data collection. The research team collected and examined: (1) institutional policy documents pertaining to technology integration and curriculum innovation; (2) minutes from the August 2023 teacher training workshop titled "Applying AI in Teaching"; (3) lesson plans and instructional materials developed for the 10-session AI curriculum across all target grade levels; (4) student work products, including AI-generated projects, algorithm diagrams, and reflection papers; (5) assessment instruments and evaluation rubrics; (6) internal memoranda and communications regarding implementation logistics; and (7) publicly available information from the school's website and promotional materials. Document analysis served not only as a primary data source but also contextualized and corroborated evidence obtained through other methods.

3.3.2. Classroom observations.

Non-participant classroom observations were conducted over a four-month period (January-April 2024) coinciding with the delivery of the 10-lesson AI series. A total of 24 observation sessions were completed, distributed across grade levels as follows: grade 1 (6 sessions), grade 2 (6 sessions), grade 3 (6 sessions), and grade 7 (6 sessions). Each observation session lasted approximately 45-50 minutes, corresponding to standard instructional periods. Observations were guided by a semi-structured protocol focusing on: (1) teacher instructional practices and technological pedagogical content knowledge; (2) student engagement and participation patterns; (3) student-student and student-teacher interactions; (4) use of AI tools and platforms; (5) manifestation of challenges identified in the literature; and (6) unanticipated events or adaptations. Observers maintained field notes documenting both descriptive accounts and reflective interpretations, subsequently expanded into detailed observation reports within 24 hours of each session.

3.4. Data analysis strategies.

Data analysis proceeded through iterative cycles of inductive and deductive coding, moving progressively from description to interpretation and theorization. The analysis followed a six-phase thematic analysis approach, which provided systematic procedures for identifying, analyzing, organizing, describing, and reporting themes within qualitative data sets.

4. Results and Discussion

4.1. AI curriculum design and pedagogical implementation at Xschool.

4.1.1. Primary education program (Grades 1–3).

Xschool's pioneering initiative to introduce artificial intelligence concepts to learners as young as six years old represents a significant departure from conventional primary curricula, both within Vietnam and internationally. As detailed in Table 1, the 10-session program for grades 1–3 was carefully sequenced to scaffold understanding from concrete experiences toward increasingly abstract conceptualizations.

Table 1. AI Implementation for grades 1, 2, and 3.

Grade	Lesson Title	Session	Implementation
1, 2, 3	What is AI?	Session 1: The Definitions of AI	The teacher conducts a warm-up activity where students predict whether images or sounds are AI-generated. The teacher then shows videos about AI and introduces the concept of artificial intelligence.
1, 2, 3	What is AI?	Session 2: Experiencing AI Tools	The teacher guides students to determine whether examples are AI through four guiding questions. Students practice using the AI tool Quick Draw.
1, 2, 3	What AI Can Do?	Session 1: Determining Whether It Is AI	The teacher invites students to identify whether objects (e.g., virtual assistants, old cars) are AI. A video on self-driving cars is shown, followed by a review of the AI concept.
1, 2, 3	What AI Can Do?	Session 2: AI's Good Tasks and Bad Tasks	Students practice AI tools such as Aaron Wong AI Tic-Tac-Toe, Einstein.digitalhumans, and Transformer (huggingface.co). Students discuss AI's strengths and limitations. They also practice using the AI tool Magic Sketchpad.
1, 2, 3	Algorithm	Session 1: What Is an Algorithm?	Students learn the concept of algorithms through practical examples (e.g., steps for making a cake).
1, 2, 3	Algorithm	Session 2: Practicing Algorithms	Students work in groups to build simple algorithms (e.g., steps for guiding a teacher out of the classroom).
1, 2, 3	Machines Can Be Trained	Session 1: Rock–Paper–Scissors Game	Students explore the Rock–Paper–Scissors game to understand how machines recognize patterns and make decisions.
1, 2, 3	Machines Can Be Trained	Session 2: Identifying Animals	Students practice training machines to identify animals (e.g., dogs, cats) and discuss how machine recognition works.
1, 2, 3	Algorithmic Bias	Session 1: Identifying Algorithmic Bias	Students learn about algorithmic bias through examples such as predicting the U.S. president and sliding scenarios.
1, 2, 3	Algorithmic Bias	Session 2: Student Actions	Students create posters proposing rules to ensure AI systems are fair and safe.

The curriculum design demonstrates several noteworthy pedagogical principles. First, it employs developmental sequencing, introducing AI through tangible, playful interactions (Quick Draw, Magic Sketchpad) before advancing to abstract concepts such as algorithms and bias. This approach aligns with Piagetian theories of cognitive development, acknowledging that young learners construct understanding most effectively through concrete operational experiences. The progression from "What is AI?" to "What AI Can Do" and ultimately to "Algorithmic Bias" reflects deliberate attention to conceptual hierarchy.

Second, the curriculum exhibits constructivist alignment, wherein learning activities directly correspond to intended learning outcomes. Students do not merely receive declarative knowledge about AI; they actively construct understanding by using AI tools, training machine learning models, and creating artifacts (algorithms, posters). This pedagogical orientation is consistent with contemporary computer science education research advocating for "creative computing" approaches that position learners as producers rather than passive consumers of technology.

Third, the inclusion of algorithmic bias instruction at the primary level is particularly striking. Introducing six-to-eight-year-old children to concepts of fairness, representation, and potential discrimination in automated systems demonstrates what could be termed "critical AI literacy"—the capacity not only to use AI but to interrogate its social implications. This finding extends beyond previous literature, which has predominantly documented AI ethics instruction at secondary or tertiary levels. Xschool's initiative suggests that young children can meaningfully engage with sociotechnical critiques when appropriately scaffolded through concrete examples (predicting presidents, sliding) and creative expression (poster design).

Nevertheless, observational data revealed substantial variation in how these lessons were enacted across different primary classrooms. While some teachers successfully facilitated rich discussions about algorithmic fairness, others defaulted to procedural instruction focused narrowly on tool operation. This implementation variability underscores the critical importance of teacher pedagogical content knowledge—not merely technical proficiency—in realizing the transformative potential of AI education.

4.1.2. Secondary education program (Grade 7).

The grade 7 curriculum, summarized in Table 2, represents a significant escalation in both cognitive demand and technical complexity, appropriately calibrated to early adolescent learners' developing abstract reasoning capacities. Several distinctive characteristics of the secondary program warrant analytical attention. First, the curriculum embodies a productive tool orientation, positioning AI not merely as an object of study but as a functional instrument for amplifying human creativity and productivity. Students learn to delegate routine compositional tasks (slide design, image generation) to AI systems while retaining authorial agency and editorial judgment. This orientation directly confronts prevalent deficit discourses framing AI as threatening human skills; instead, it models human-AI collaboration as an augmentative relationship.

Table 2. AI implementation for Grade 7.

Grade	Lesson Title	Session	Implementation
7	AI Introduction	Sessions 1–2	Introduction to AI, history of AI development, and the role of AI in everyday life. Explanation of AI operating principles. Overview of common AI applications such as Artificial Intelligence Systems (AIIS), self-driving cars, and voice recognition.
7	Using AI to Create Creative PowerPoint Slides, Photos, and Videos	Sessions 3–4	Introduction to applying AI in daily work, including creating PowerPoint slides using gamma.app. Instructions for using online tools or PowerPoint plugins to design professional slides. Introduction to AI technologies for generating photos and videos. Guidance on using Canva with AI features to create profile photos, cover photos, and creative images.
7	AI in Scratch Programming	Sessions 5–6	Instructions for using Scratch to create simple AI-related projects. Discussion of the website MachineLearningForKids.co.uk and how it integrates AI with Scratch programming.
7	Working with Q&A AI Tools	Sessions 7–8	Introduction to Q&A AI tools and their role in providing information and user support. Overview of popular platforms such as OpenAI's GPT, Gemini, and Microsoft Copilot. Explanation of the basic operating principles of AI Q&A systems and how natural language processing enables them to understand and answer questions.
7	Rights and Privileges in the Context of Artificial Intelligence	Sessions 9–10	Explanation of the concepts of rights and privileges and their differences. Analysis of examples of rights and privileges before the emergence of AI. Analysis of examples in the context of AI development. Discussion of updated rights related to AI at the time of teaching, supported by specific examples.

Second, the program demonstrates vertical articulation with the primary curriculum while introducing qualitatively new dimensions. Where grade 3 students explored machine learning through animal identification, grade 7 students advance to constructing AI-integrated Scratch projects via MachineLearningForKids. This progression from consumer to creator of simple AI applications reflects Vygotskian principles of scaffolding within the zone of proximal development, wherein learners are continually challenged to extend their capabilities with appropriate support structures.

Third, the culminating unit on rights and privileges represents sophisticated civic education in the technological domain. By historicizing rights through comparative analysis of pre-AI and AI-era contexts, the curriculum cultivates what could be termed "sociotechnical citizenship"—the capacity to participate knowledgeably in democratic deliberation about technological governance. This unit transcends narrow conceptions of AI literacy as technical upskilling, instead framing AI understanding as integral to contemporary civic competence.

However, classroom observations revealed a persistent tension between generative and substitutive uses of creative AI tools. When instructed to create PowerPoint slides using gamma.app, several students generated complete presentations with minimal cognitive engagement, effectively outsourcing their thinking to the AI system. This phenomenon—which we term "cognitive offloading without metacognitive monitoring"—represents an emergent challenge for which Xschool teachers were inadequately prepared. It suggests that teaching with generative AI requires not merely technical instruction but explicit pedagogical strategies for fostering critical engagement with AI outputs.

4.2. Teacher-level challenges in AI implementation.

The implementation experiences at Xschool illuminate a constellation of interrelated challenges confronting teachers, several of which resonate with and extend beyond existing literature. These challenges are not discrete phenomena but dynamically interacting barriers operating across individual, institutional, and systemic levels.

4.2.1. Insufficient training and professional development.

Consistent with Chiu and Chai's [16] identification of teachers' insufficient technological knowledge as a barrier to AI integration, Xschool teachers reported that the single internal workshop conducted in August 2023 was inadequate preparation for classroom implementation. This finding extends the literature by distinguishing between personal technological competence and pedagogical technological competence—the capacity to translate one's own understanding into developmentally appropriate instruction for others. The former may be necessary but is demonstrably insufficient for effective teaching. Effective professional development must therefore address not only "what is AI?" but "how do I teach AI to diverse learners with varying cognitive capabilities and prior knowledge?" Furthermore, the timing and format of professional development proved problematic. The single workshop preceded curriculum implementation by eight months, creating a temporal gap during which teachers' nascent skills atrophied. Several teachers reported independently seeking supplementary training through online courses and YouTube tutorials, revealing both commendable professional initiative and institutional failure to provide ongoing, just-in-time support.

4.2.2. Complexity of AI tools and Non-STEM teacher backgrounds.

Xschool's experience corroborates previous research identifying tool complexity as a significant implementation barrier [14], while revealing previously undertheorized dimensions of this challenge. This finding challenges the assumption that teachers need only develop proficiency with observable tool functions. Students' intellectual curiosity frequently extends beneath the interface to foundational questions about AI operation, and teachers lacking disciplinary preparation in computer science struggle to address these inquiries. This suggests that AI teacher preparation must include not only pedagogical strategies but foundational conceptual knowledge sufficient to support authentic intellectual exchange with students.

4.2.3. Curriculum integration and curricular coherence.

Teachers encountered substantial difficulty aligning AI lessons with existing curriculum requirements, particularly regarding the Vietnam Ministry of Education and Training's prescribed Computer Science standards. This finding identifies a structural contradiction in AI integration initiatives: they typically constitute additive rather than integrated curriculum reforms. Absent systematic curriculum revision that embeds AI learning within, rather than alongside, existing subject matter requirements, AI instruction creates zero-sum competition for instructional time. Teachers are positioned as curriculum architects without formal authority or adequate support to redesign scope and sequence documentation.

4.2.4. Resistance to change and organizational culture.

While overt resistance to AI integration was less prevalent than anticipated—likely attributable to Xschool's institutional culture emphasizing innovation—more subtle forms of resistance emerged. This sentiment, which we characterize as reform fatigue, represents a qualitatively distinct form of resistance distinct from skepticism about AI's educational value. It suggests that resistance may be less about technology acceptance than about the accumulated burden of prior reform efforts. Institutional strategies for AI integration must therefore acknowledge and address teachers' reform histories, not merely their attitudes toward AI.

4.2.5. Assessment and evaluation challenges.

Consistent with Lu's [15] findings regarding AI-based scoring inaccuracies, Xschool teachers struggled to develop appropriate assessment methodologies for AI learning outcomes. This challenge reflects a fundamental misalignment between traditional assessment paradigms predicated on decontextualized knowledge demonstration and emerging learning objectives emphasizing critical thinking, ethical reasoning, and creative application. Developing authentic assessment approaches for AI literacy—portfolio assessment, project-based evaluation, computational thinking rubrics—represents an urgent frontier for educational research and practice.

4.3. Student-level challenges in AI learning.

The student challenges documented at Xschool both confirm and significantly extend existing understandings of barriers to K-12 AI education.

4.3.1. Developmental appropriateness of abstract concepts.

The difficulty primary students experienced grasping algorithmic thinking corroborates Piagetian developmental theory, which positions formal operational reasoning as emerging during early adolescence. However, observations suggested that pedagogical mediation significantly modulated this challenge. When teachers employed embodied pedagogies—having students physically enact algorithm steps by walking through sequences—comprehension improved markedly. This suggests that the challenge is not whether abstract AI concepts can be taught to young children but how they are taught. The literature's prevailing emphasis on developmental constraints may underestimate the potential of well-designed, concretized instruction.

4.3.2. Access and equity considerations.

While Xschool's private-resource context mitigated the severe technological inequities documented in public school settings [12], subtle equity issues nevertheless emerged. Students with home computer access demonstrated greater fluency with AI tools than those whose only access was school-based, creating within-classroom disparities that teachers found challenging to address. This finding suggests that even in well-resourced schools, digital divides persist along dimensions of access location and frequency, not merely binary access/non-access distinctions.

4.3.3. Linguistic and cultural translation.

The language barrier challenge identified at Xschool extends beyond mere translation of English terminology into Vietnamese. This finding reveals that AI curriculum resources produced in Western contexts carry embedded cultural assumptions requiring not merely linguistic translation but cultural localization. Effective AI education in non-Western contexts demands indigenous development of examples, case studies, and applications reflecting local realities, priorities, and cultural reference points.

4.3.4. Engagement and sustained motivation.

Student engagement patterns varied significantly across grade levels and instructional approaches. Primary students exhibited high initial enthusiasm for interactive AI tools but waning attention during conceptual instruction. Grade 7 students demonstrated the inverse pattern: initial skepticism about AI's relevance followed by deeper engagement during rights and privileges discussions. This developmental reversal suggests that motivational profiles for AI learning differ substantially by age and should inform differentiated pedagogical approaches. Particularly promising was the observed transfer of learning when students recognized AI applications in their daily lives beyond the classroom. Several grade 7 students reported independently identifying AI systems in social media platforms and discussing algorithmic content curation with family members. Such authentic application represents the ultimate objective of AI literacy education and suggests that the Xschool initiative, despite implementation challenges, achieved meaningful educational impact.

4.4. Synthesis and theoretical implications.

The Xschool case illuminated the multidimensional nature of AI implementation in K–12 contexts, revealing complex interactions among curriculum design, teacher preparation, institutional capacity, and student developmental readiness. These findings collectively suggested that effective AI integration required systemic, not merely additive, approaches to educational change. Isolated interventions—whether teacher workshops, curriculum materials, or technology acquisition—proved insufficient in the absence of coherent alignment across policy, professional learning, curriculum, assessment, and organizational culture dimensions.

The case also contributed to emerging theoretical understandings of AI literacy as a multifaceted construct. Xschool's experience demonstrated that AI literacy encompassed not only technical knowledge (what AI is and how it works) and applied skills (how to use AI tools), but also critical/evaluative capacities (how to assess AI outputs and limitations) and ethical/societal understanding (how AI affects human rights and social equity). This expanded conceptualization had significant implications for curriculum development, assessment design, and teacher preparation.

Furthermore, the Vietnamese context of this study contributed to decentering the predominantly Western literature on K–12 AI education. While Xschool's private, urban, resource-advantaged status limited direct generalization to Vietnam's majority public school sector, the case nevertheless demonstrated that meaningful AI education was feasible in non-Western, non-English-dominant contexts when appropriate localization efforts were undertaken. This finding challenged deterministic assumptions that AI education had to follow Western curricular models and offered hope for culturally responsive, locally relevant AI pedagogies worldwide.

5. Conclusions

Implementing AI in Vietnamese primary and secondary schools provides significant obstacles that demand smart solutions. These include assuring equal access to technology, offering extensive teacher training, and modifying curricula to incorporate AI instruction. By encouraging cooperation among teachers, curriculum developers, policy makers, and technology suppliers, Vietnam may effectively negotiate these hurdles, paving the path for inclusive and impactful AI inclusion in its educational system. It is implied that some solutions are given to deal with challenges: (1) Infrastructure Development: Ensure schools have necessary technology and digital literacy programs; (2) Curriculum Development: Integrate AI modules into subjects and include discussions on ethics; and (3) Teacher Training Programs: Provide ongoing professional development and promote collaborative learning.

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Author Contribution

Conceptualization: Nguyen Thi Thao Ho, Ly Thi Khanh Pham; Methodology: Nguyen Thi Thao Ho, Ly Thi Khanh Pham; Data Collection: Nguyen Thi Thao Ho, Ly Thi Khanh Pham; Data Analysis: Nguyen Thi Thao Ho, Ly Thi Khanh Pham; Writing: Nguyen Thi Thao Ho, Ly Thi Khanh Pham; Supervision: Ly Thi Khanh Pham

Competing Interest

The authors declare no competing interests.

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