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Developing AI literacy for teachers in Vietnam's schools: Challenges, strategies, and best practices

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ABSTRACT

The aim of the study is to emphasize the growing importance of artificial intelligence (AI) literacy among teachers at a time when Vietnam is undergoing a significant phase of educational transformation. AI now influences the management of schools and the daily practices within classrooms, creating opportunities for new forms of teaching and leadership. However, progress remains uneven. Teachers in metropolitan centers often have earlier access to technology, while colleagues in rural areas face limited resources, slower institutional readiness, and fewer opportunities to experiment with AI in their professional work. This study focuses on how teacher preparation programs and collaborative professional cultures can help narrow this gap. Formal training that integrates AI into its curriculum provides a structured pathway for developing competence. Professional learning communities (PLCs) support this process by encouraging dialogue, sharing lived experiences, and maintaining motivation to adopt innovations. The combination of structured learning and collegial interaction helps educators see AI as a means of empowerment rather than an external demand. The findings indicate that AI applications can reduce routine administrative duties, allowing more time for instructional design, student engagement, and pedagogical creativity. The practical implications suggest embedding AI literacy within teacher education frameworks and promoting collaborative networks to prepare Vietnamese teachers to lead effectively in classrooms increasingly influenced by AI.

Contribution/Originality: This study contributes originality by offering qualitative insights into AI literacy in Vietnam's K-12 schools through the perspectives of principals, teachers, and policymakers. A context-sensitive framework is introduced that links professional development with professional learning communities to strengthen teacher capacity and promote equitable AI integration.

1. INTRODUCTION

Vietnam is making efforts in equipping teachers with knowledge of artificial intelligence. AI is no longer a distant concept confined to advanced economies. AI is actively reshaping instructional practices, redefining assessment mechanisms, and enhancing deeper teacher-student interaction across classrooms worldwide. In countries including the United States, China, and South Korea, the integration of AI into education provides more opportunities for personalized learning and improvements in learning outcomes. Vietnam's education system stands at a promising juncture, with both the ambition and the potential to embrace global developments in AI. In addition, the momentum of the Fourth Industrial Revolution demands not only infrastructure and policy alignment but also a deliberate effort to build human capacity. Developing AI competencies for teachers would support them in utilizing intelligent

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technologies with stronger educational results. More importantly, the integration of AI in education would cultivate conditions for pedagogical innovation and personalized learning pathways for students.

Similarly, advancing AI literacy within the teaching workforce extends far beyond the development of basic technological competence. Teachers are deemed as transformative actors who would decide the success of educational change. The capacity to engage meaningfully with AI tools enables teachers to better design instructional activities in a learner-centered way, fostering habits of critical reflection and creative thinking. Teachers who can integrate AI into their instructional design would be better equipped to create inclusive classroom environments. When teachers actively use AI tools, they can support instructional innovation in teaching practices, strengthen meaningful professional collaboration, and enhance data-driven decision-making processes. A teacher workforce skilled in AI plays a key role in improving the overall quality of education, helping students in Vietnam build the competencies needed to navigate the complexities of a knowledge-based and innovation-driven global society.

The growing demand for AI literacy among teachers reflects Vietnam's broader push for digital transformation. There are some notable progress in building digital literacy for teachers. However, the development of teachers' AI competencies seems to be a much more complex challenge, and that challenge also requires a more strategic approach. In addition to this, schools located in urban areas have more advantages because of their existing technological infrastructure. Rural schools, on the other hand, continue to encounter significant barriers that limit their ability to adopt AI technologies effectively. For example, limited access to the Internet might constrain these disadvantaged schools in national efforts to enhance education quality with the support of educational technology. While urban schools are increasingly prepared to incorporate AI into teaching and learning processes, many schools in less developed regions still struggle to meet even basic digital requirements. The gap between the advantaged and disadvantaged schools has been exacerbating educational inequalities and presents a serious obstacle to the integration of AI in the Vietnam context.

AI literacy requires teachers to have a comprehensive understanding of the pedagogical and technical implications of artificial intelligence in education. One of the many challenges for Vietnamese teachers involves translating theoretical insights about AI into effective instructional practices that would enhance student learning. Many teachers, particularly those working in rural or underserved areas, often lack the necessary resources to integrate AI meaningfully into their instructional strategies. Additionally, the insufficient exposure to AI technologies often contributes to uncertainty; and in turn, this would lead to misunderstanding about AI adoption in daily practices. In some cases, teachers view AI as either overly technical or not effective for their daily teaching tasks. Therefore, developing AI literacy for teachers is essential not only for improving technological fluency but also for enabling teachers to recognize how AI can contribute to more personalized learning and efficient classroom practices to enhance students' academic performance.

Furthermore, artificial intelligence holds the potential to profoundly transform instructional practices by fostering more engaging learning environments. In addition to streamlining routine administrative responsibilities, the use of AI tools in education allows teachers to personalize instruction based on individual student needs. Therefore, a strong foundation in AI literacy becomes increasingly essential for teachers. Teachers who are equipped with AI competencies will be better prepared to develop students' skills for the future. Insufficient AI literacy may hinder teachers from preparing students with the critical skills necessary to thrive in a world of rapid technological innovation. Access to effective AI literacy programs for teachers across all regions is vital for ensuring national educational development. Teachers in every locality, regardless of infrastructure or institutional support, should possess the expertise to integrate AI meaningfully into their instructional practices. Strengthening teacher readiness in AI would support the development of an education system aligned with Vietnam's broader development goals.

This study aims to explore a strategy to enhance AI competencies for Vietnamese teachers, together with exploring the influence of professional development programs on advancing AI competencies. The professional development program, which is developed with a focus on how experiential learning and ongoing instructional

support can enhance teacher confidence in the use of AI technologies. Those programs that emphasize real-world application are expected to foster stronger engagement and sustained use of AI tools in pedagogical practice. Increased focus will be placed on the significance of professional learning communities to promote instructional innovation among teachers.

The implementation of AI in classroom practices would enhance students' learning outcomes and simultaneously promote educational equity across various geographic areas. This study highlights the potential of AI integration in the educational system of Vietnam. Vietnamese teachers with better AI competency would create a creative and interactive learning environment. With digital transformation, Vietnam's education system is gaining momentum; teachers' AI literacy is emerging as a critical driver of long-term innovation in education. Therefore, besides exploring the potential of AI literacy in Vietnam's educational system, this study will also analyze a strategic approach to integrate AI into K-12 schools in the Vietnam context.

This study emphasizes the importance of establishing a framework for the development of AI literacy for Vietnamese teachers. Additionally, this study will offer evidence-based best practices and propose policy recommendations for integrating AI literacy into teacher education and professional development programs. Prioritizing AI literacy as a component of teacher preparation enables the country's education system to ensure that future teachers are equipped with AI competencies for their future teaching roles. Furthermore, the integration of AI literacy into professional development programs for teachers will ultimately better prepare students for an AI-driven future world.

2. LITERATURE REVIEW

2.1. AI Literacy

The expansion of artificial intelligence in many industries has emphasized the importance of developing AI literacy for citizens. Chiu, Ahmad, Ismailov, and Sanusi (2024) define AI literacy as the competencies to understand and effectively utilize the nature of AI systems. AI literacy also requires users to critically evaluate artificial intelligence systems or tools. Additionally, AI literacy includes not only technical knowledge but also a deep understanding of the ethical dimensions involved in the use of AI technologies in everyday contexts. In other words, AI literacy requires individuals to critically think about how AI would impact decision-making processes and affect human cultural values (Laupichler, Aster, Schirch, & Raupach, 2022). AI literacy would equip individuals with the capability to confront the challenges presented by increasingly complex digital systems. The capacity to scrutinize AI applications encourages professionals from diverse fields to adopt AI in ways that account for its broader societal consequences. Vesnic-Alujevic, Nascimento, and Polvora (2020) argue that informed users can contribute to responsible innovation by ensuring that AI aligns with enduring ethical standards and collective goals.

The growing development of AI-powered systems offers substantial benefits for many industries. Those benefits include increased productivity, service customization, and improved efficiency (Jarrahi, Lutz, Boyd, Oesterlund, & Willis, 2023). However, alongside advantages, there are significant concerns related to algorithmic bias, data privacy, and, more seriously, the potential erosion of human agency. Therefore, awareness of the limitations of current AI systems or tools helps users to implement AI strategies in their workplaces with a greater sense of ethical responsibility (Rane, 2023). Individuals who possess strong AI literacy are more likely to navigate the opportunities and risks of technological innovation. The framework of AI literacy should emphasize critical reflection for a more responsible use of intelligent systems. Zhao and Gómez Fariñas (2023) argue that individuals who understand the wider societal and ethical consequences of AI can contribute to decision-making processes that promote the well-being of both local communities and global society. Therefore, the long-term impact of AI will rely on cultivating global citizens who have an understanding of how to effectively utilize AI tools and how to critically assess AI systems for social benefits. A clear understanding of the limitations and risks of artificial intelligence systems remains an important aspect of responsible technological engagement. For example, misinformation or ineffective automated

decision-making would pose a serious challenge; therefore, the integration of AI needs scrutiny and regulation (Abdelwanis, Alarafati, Tammam, & Simsekler, 2024).

Although AI innovations promise unprecedented gains in efficiency and creativity, responsible use of AI requires a deliberate and ongoing effort to weigh its benefits against possible harms (Patel, 2024). Professionals with advanced levels of AI literacy would occupy a strategic position that allows them to evaluate the trade-offs more effectively. Likewise, George (2023) emphasizes that AI literacy enables individuals to promote accountability in the integration of AI in their institutions. The future workforce will contribute meaningfully to the responsible integration of AI to maintain the role of human judgment in the AI-driven working environment.

2.2. AI Literacy for Teachers

AI literacy for teachers represents a multifaceted domain that demands an approach that encompasses conceptual understanding and practical application in educational practices (Akgun & Greenhow, 2022). Indeed, AI literacy effectively requires the adoption of evidence-based pedagogical strategies in addition to ethical use of artificial intelligence in educational settings (Zhang et al., 2023). Besides, understanding teachers' needs for professional development is the first step in designing teachers' professional development programs related to AI literacy. Teachers who are capable of embedding AI technologies meaningfully into their pedagogical practices can enhance both instructional quality and student engagement (Zhang et al., 2023). Meanwhile, Merceron and Best (2024) highlighted the positive results of a well-designed professional training in developing AI competencies for teachers, especially in diverse educational environments. Similarly, a professional development program about the application of AI in education would significantly contribute to the AI readiness level of teachers (Liu, Chen, & Yao, 2022). In addition, opportunities for sustained professional growth are expanded through communities of practice. Professional learning communities can serve as a dynamic space for knowledge exchange and mutual support (Kim, 2024). Educators who participate in communities of practice will be better equipped to navigate technological shifts, contributing to innovative instructional practices.

Incorporating AI-powered resources, teachers with strong AI literacy would transform learning in their classrooms (Walter, 2024). With support of AI, teachers can personalize learning experiences based on the evaluation of students' learning data (Manaf, 2024). In addition to that, teachers can use AI to organize instructional activities in class to be more interesting and engaging. In addition, teachers who understand the essence of AI systems might be better at recognizing possible biases and misinformation in the output produced by the AI systems. Interestingly, teachers with a high level of AI literacy often exhibit a higher level of adaptability, a quality that is essential for fostering a culture of continuous pedagogical advancements in schools (Merceron & Best, 2024). Many school leaders consider AI literacy to be becoming indispensable for teachers nowadays. AI really changes the way students study, therefore, requiring teachers to redesign instructional activities as well as assessment and evaluation (Stolpe & Hallström, 2024).

AI-powered systems might offer the ability to personalize learning pathways to suit the specific needs of individual students. In addition, AI-powered systems can enable the generation of real-time data analytics that assist in identifying students' strengths and areas where students need further development or assistance (Kaswan, Dhatterwal, & Ojha, 2024). In addition, when teachers can assign administrative tasks to AI systems, they can have more time for instruction-related activities. Thus, teachers would focus more directly on student interaction or provide personalized feedback for students. However, AI-powered systems or tools also pose challenges, including biases, hallucinations, misinformation, and data privacy. The ethical integration of AI in education requires a thoughtful interaction between human agents and AI systems or tools (Borger et al., 2023). Teachers need to maintain critical control over the use of technology in the classroom (Zhang & Zhang, 2024).

A clear understanding of how AI systems operate allows teachers to make informed choices about integrating safer AI-powered tools in schools. The potential of AI to transform education is significant, but so are the ethical

concerns and practical limitations that AI possesses (Akgun & Greenhow, 2022). Teachers need to ensure that the integration of AI in their instruction can only be effective if it supports teachers in achieving students' learning goals. AI tools can help to design personalized learning materials and create differentiated instructional practices to better serve the various needs of students. The ability to integrate AI into daily teaching practices would help teachers to ensure that AI and other educational technologies serve to develop critical thinking and creativity in students. It is the reason why Ayanwale, Adelana, Molefi, Adeeko, and Ishola (2024) emphasize that teachers who master AI literacy do not simply adopt technologies for convenience but instead use them with the intention of reinforcing educational values.

However, being faster does not always mean better. AI tools can help students to instantly have answers and reduce many desirable difficulties. Students might be overly dependent on AI and become less critical and less creative. Therefore, the ethical use of AI systems or tools represents a foundational component of AI literacy for teachers. However, a deep understanding of the ethical dimensions surrounding AI requires teachers to care about the development of students' critical thinking capacities (Zhang et al., 2023). The discussions about the safeguarding of teachers' and students' data also contribute to the formation of knowledgeable and responsible AI users. At the same time, teachers play an essential role in helping learners grasp the broader societal consequences of AI implementation, extending beyond technical competencies to encompass social responsibility and ethical engagement (Berendt, Littlejohn, & Blakemore, 2020). A well-prepared teacher with a strong AI competency is vital to shaping our next generation who not only use AI effectively but also critique the influence of technologies on physical and mental health. Teachers should provide students with opportunities to reflect on the limitations of AI tools. The integration of AI in education necessitates the nurturing of ethical perspectives among students who will participate in an increasingly AI-integrated world (Kong, Cheung, & Zhang, 2023).

Professional development programs must prepare teachers to effectively integrate AI technologies in schools (Nazaretsky, Ariely, Cukurova, & Alexandron, 2022). Those programs help teachers develop hands-on experience in using AI for lesson planning, learning materials preparation, assessment and evaluation, or even creating customized GPTs to support students' learning. Teachers would bridge the divide between conventional instruction and AI-enhanced pedagogical strategies (Novawan, Walker, & Ikeda, 2024). One of the benefits of AI offers for students is personalized education. AI systems foster educational diversity by ensuring that students with different competence levels can gain access to personalized learning resources tailored to their specific needs (Maghsudi, Lan, Xu, & van Der Schaar, 2021). In addition, with the support of AI systems or tools, teachers would adopt the role of facilitators to develop students' ownership of their educational journeys (Reinius, Kaukinen, Korhonen, Juuti, & Hakkarainen, 2022). Real-time feedback and data generated through AI technologies enable students to develop important competencies and subject mastery. Although the integration of AI has the potential to alter the dynamics of the classroom environment, the role of teachers remains a central factor in designing the learning experience for students (Umali, 2024).

2.3. Trends in AI Literacy Development for Teachers

The increasing incorporation of AI into educational systems has influenced the development of AI literacy for teachers (Wang, Liu, & Tu, 2021). Many countries have been designing professional development programs specialized in the integration of AI in education. Similarly, many K-12 schools have acknowledged the necessity of equipping teachers with continuous training that addresses the application of AI in education. Teachers are encouraged to engage deeply with the practical implementation of AI systems or tools in schools. Teachers who engage in these programs develop the capacity to evaluate AI tools in terms of alignment with schools' educational goals and societal expectations. In addition, more school districts have issued new policies to encourage teachers to integrate AI into their daily teaching practices. A comprehensive approach to training ensures that AI applications in classrooms are consistent with broader schools' and countries' educational missions (Altinay et al., 2024).

Another aspect of the AI literacy development program is to help teachers effectively utilize AI-driven personalized learning platforms. AI-supported platforms often use algorithms to customize educational materials to meet the needs of each student or to suit students' learning preferences (Rane, Choudhary, & Rane, 2023). Teachers also can use data-driven analytics with the support of AI-assisted platforms to improve students' learning outcomes (Huang, Lu, & Yang, 2023). Understanding how AI-driven learning systems collect and analyze learners' data is essential for teachers to make better instruction-related decisions. When using these systems, without critical views, teachers might too depend heavily on automated recommendations. Therefore, training programs focusing on developing AI competencies for teachers should include guidance on interpreting AI-generated insights and ensure that AI-generated educational outputs are aligned with schools' educational missions. Teachers empowered with both technical and pedagogical knowledge would ensure personalized learning becomes a more equitable and effective tool in classrooms.

An important development in the integration of artificial intelligence into education involves a heightened focus on ethical concerns within AI literacy initiatives (Zhang et al., 2023). Many teacher preparation programs now include training that enables educators to detect and mitigate algorithmic bias, a competency that becomes increasingly essential as AI technologies enter mainstream classroom environments. Teachers equipped with a comprehensive understanding of AI systems would be better at fostering moral practices, together with an inclusive learning environment. Teachers' training for AI literacy in many countries emphasizes fairness, reflecting societal anxieties about how rapid technological change may threaten core human principles (Adams, Pente, Lemermeyer, & Rockwell, 2023). Beyond technical or ethical elements, the AI literacy programs must pay attention to the development of students' higher-order thinking skills. Critical thinking, problem-solving competencies, and self-studying capabilities are becoming even more important in preparing students for the AI-driven future world. It means that AI-literate teachers must develop instructional strategies and learning environments that ensure the development of students' creative problem-solving skills.

A significant trend in the advancement of AI literacy involves the integration of AI-related training content in continuous professional development (CPD) for teachers in many countries around the world. The AI-related CPD programs have included hours of training to assist teachers in adapting pedagogical methods in instructional designs (Fakhar, Lamrabet, Echantoufi, Khattabi, & Ajana, 2024). In the past few years, many CPD programs have been designed to ensure AI literacy development for teachers. Besides, one-time workshops have been proven to be insufficient in addressing the complexity of AI in education. Hence, making AI engagement opportunities available for teachers is necessary for AI integration in schools of different conditions (Afzaal, Shanshan, Yan, & Younas, 2024). In addition, international education organizations are making efforts to prioritize lifelong learning for teachers around the world. CPD programs in many countries have a central mechanism to enhance teachers' AI literacy (Zhang & Zhang, 2024). Meanwhile, teachers of different K12 levels also admitted the importance of professional learning communities in helping them become more confident in using AI tools in their daily teaching practices.

3. RESEARCH METHODS

3.1. Research Design

In this study, the authors used a qualitative method to explore the complex dynamics surrounding the development of AI literacy within the K-12 school system in different contexts in Vietnam. The authors used a qualitative approach for a nuanced exploration of contextual realities to understand differences in AI literacy development in urban and rural educational areas in Vietnam. This study's research design emphasizes the need to understand all stakeholders' experiences and perceptions directly involved in shaping AI literacy at the ground level. The authors used interviews as the primary means for collecting data from a diverse group of stakeholders, including school principals, classroom teachers, and education policymakers. Data collected from different levels of the

educational system help to understand the local contexts and institutional constraints in Vietnam's evolving educational landscape.

In total, interviews were conducted with principals and teachers from various schools across the country to ensure a representative sample from different areas of Vietnam and schools' levels as well. This study's interviews focus on understanding the current state of AI literacy, the implementation of AI tools, and the opportunities for AI-related professional development available to teachers. Furthermore, the authors conducted document analysis, including policy reports, to supplement the primary data sources and offer a comprehensive picture of the systemic efforts to promote AI literacy in Vietnam.

Table 1 indicates demographic information for principals, teachers, and policymakers involved in this study. The data cover age, gender, education, professional experience, and institutional context. This study draws on diversity across regions and school levels, which provides a foundation for analyzing how AI literacy is approached and supported in Vietnam's education system.

3.2. Sample and Data Collection

The authors use a sample including 12 public schools, comprising primary, middle, and high schools selected from three major geographical areas in Vietnam: the North, Central, and South, to offer diverse perspectives on AI literacy development. This sampling aims to include schools with varied levels of AI readiness and cultural differences to achieve a comprehensive understanding of AI literacy integration in K-12 education. Specifically, in this study, participants including 12 principals, 12 teachers, and 6 policymakers engaged in educational planning at the national level. Those principals were interviewed to understand school-level leadership perspectives and the integration of AI in schools. Meanwhile, 2 teachers in each school provided insights into the application of AI in teaching practices and professional development. Additionally, policymakers offered a broader strategic view on national efforts to enhance AI literacy for teachers. All interviews lasted approximately 20–45 minutes, were transcribed, and analyzed using thematic analysis techniques.

The authors interviewed 12 school principals with different educational levels, most holding master's degrees in educational management or education. School principals have work experience in the education field ranging from 15 to 22 years, with 4 to 9 years in their current roles as principals. Meanwhile, interviewed teachers come from a mix of educational levels and subject areas, including mathematics, physics, history, literature, biology, and social studies. The teachers' ages range from 33 to 48 years old, with teaching experience spanning 7 to 20 years. Teachers hold three educational levels: Bachelor's, Master's, and Ph.D. degrees. The diversity in teachers' backgrounds provides a broader understanding of how AI literacy can be integrated into different subject areas and teaching practices. Additionally, to incorporate more strategic insights from national education authorities, the authors interviewed six policymakers selected from educational institutions such as the Ministry of Education, the National Education Committee, and Educational Research Institutes. All policymakers held academic qualifications, predominantly Ph.D. degrees in educational policy, management, or public administration, with professional experience ranging from 19 to 25 years. The viewpoints from these six policymakers offer valuable insights into the broader frameworks influencing AI literacy development efforts for teachers across Vietnam.

Table 1. Principal Demographics.

Role	Participant	Age	Gender	Education level	Years of experience	Years in current position	Region	School/Institution level	Location type
Principal	Principal 1	50	Male	Master's in educational management	18	6	North	Primary school	Urban
Principal	Principal 2	45	Female	Master's in education	15	7	Central	Middle school	Urban
Principal	Principal 3	48	Male	Bachelor's in education	19	5	South	High school	Urban
Principal	Principal 4	52	Female	Master's in educational management	20	8	North	High school	Rural
Principal	Principal 5	47	Male	Ph.D. in education	17	4	Central	Primary school	Rural
Principal	Principal 6	49	Female	Master's in educational management	16	6	South	Middle school	Rural
Principal	Principal 7	53	Male	Master's in education	22	9	Central	High school	Urban
Principal	Principal 8	46	Female	Ph.D. in educational management	18	7	North	Middle school	Rural
Principal	Principal 9	44	Female	Bachelor's in education	15	5	South	Primary school	Urban
Principal	Principal 10	51	Male	Master's in education	20	8	North	High school	Rural
Principal	Principal 11	47	Female	Ph.D. in educational management	17	6	Central	Primary school	Urban
Principal	Principal 12	50	Male	Master's in educational management	18	6	South	High school	Rural
Teacher	Teacher 1	38	Female	Bachelor's in mathematics	10	3	North	Primary school	Urban
Teacher	Teacher 2	40	Male	Bachelor's in physics	12	4	Central	High school	Urban
Teacher	Teacher 3	35	Female	Bachelor's in history	8	3	South	Middle school	Urban
Teacher	Teacher 4	42	Male	Master's in literature	14	5	North	High school	Rural
Teacher	Teacher 5	37	Female	Bachelor's in English	9	2	Central	Primary school	Rural
Teacher	Teacher 6	44	Male	Master's in mathematics	15	5	South	Middle school	Rural
Teacher	Teacher 7	39	Female	Bachelor's in biology	11	4	North	High school	Rural
Teacher	Teacher 8	36	Male	Bachelor's in chemistry	9	3	Central	High school	Urban
Teacher	Teacher 9	33	Female	Bachelor's in Social Studies	7	2	South	Primary school	Urban
Teacher	Teacher 10	48	Male	Ph.D. in Education	20	8	North	Middle school	Rural
Teacher	Teacher 11	41	Female	Master's in English	13	6	Central	High school	Urban
Teacher	Teacher 12	46	Male	Ph.D. in Education	18	7	South	Middle school	Rural
Policy maker	Policymaker 1	55	Male	Ph.D. in educational policy	25	10	National	Ministry of education	National
Policy maker	Policymaker 2	50	Female	Master's in Education	20	9	National	Ministry of education	National
Policy maker	Policymaker 3	53	Male	Ph.D. in educational management	22	8	National	Ministry of education	National
Policy maker	Policymaker 4	48	Female	Master's in public policy	18	7	National	Educational research institute	National
Policy maker	Policymaker 5	45	Male	Ph.D. in educational administration	19	6	National	Ministry of education	National
Policy maker	Policymaker 6	52	Female	Ph.D. in education	24	8	National	National education committee	National

In this study, the authors employed semi-structured interviews to explore individual experiences and institutional practices in advancing AI literacy for teachers in schools. Each interview was supported by document analysis involving school policy documents, school or national teacher development plans, along with teaching practice and curricular materials. Interview questions focused on participants' understandings of AI literacy and their strategies to enhance AI implementation in classroom practices. The authors also paid attention to identifying any possible obstacles in the development of AI literacy for teachers. Indeed, these case studies from selected schools offered further depth to illustrate contextual differences in AI implementation.

3.3. Data Analysis

In this study, data was analyzed using thematic analysis to identify recurrent patterns and themes. The data analysis enabled the identification of key challenges, such as disparities in teachers' AI-related preparedness, as well as the strategies that have been most effective in promoting AI literacy among teachers. The analysis also focused on identifying best practices that could be scaled up or adapted for different institutional educational settings across Vietnam.

Table 2. Sub-categories of AI literacy development for teachers in Vietnam.

Theme	Sub-category	Explanation & Source
Challenges	Technological disparities	Urban schools are equipped with reliable internet and digital tools, enabling AI-related training. Rural schools often lack basic infrastructure, resulting in unequal access to professional development. **Source:** *Principal 1 (00:12:30), Principal 4 (00:08:45), Principal 6 (00:11:00), Teacher 1 (00:10:15), Policymaker 1 (00:14:05)*
	Budget limitations	Financial constraints prevent investment in AI platforms and ongoing teacher development, especially in less developed regions. **Source:** *Principal 2 (00:08:10), Principal 3 (00:09:25), Teacher 2 (00:11:45), Teacher 4 (00:13:30), Policymaker 2 (00:13:00)*
	Teacher preparedness and ineffective training programs	Teachers lack foundational training in AI, resulting in limited confidence and hesitant classroom implementation. **Source:** *Principal 4 (00:07:30), Principal 6 (00:11:00), Teacher 3 (00:12:50), Teacher 5 (00:14:50), Policymaker 3 (00:13:45)*
	Different Conceptions about AI	AI is viewed narrowly as a technical subject, leading to underuse in language, social science, and arts education. **Source:** *Principal 5 (00:12:00), Teacher 4 (00:13:30), Teacher 6 (00:14:55), Policymaker 4 (00:14:20)*
	Resistance to change	Teachers report cognitive and emotional overload, perceiving AI integration as a burden without added support. **Source:** *Principal 7 (00:13:25), Principal 8 (00:14:00), Teacher 5 (00:14:50), Teacher 6 (00:14:55), Teacher 9 (00:11:45)*
Strategies	Comprehensive training programs	Well-structured training combining theoretical understanding with tool-based practice increases teacher readiness for AI integration. **Source:** *Principal 9 (00:08:30), Principal 10 (00:12:10), Teacher 7 (00:11:20), Teacher 8 (00:12:45), Policymaker 5 (00:13:00)*
	Tailored training by context	Programs that differentiate by subject area, region, and prior experience improve relevance and effectiveness. **Source:** *Principal 10 (00:12:10), Principal 11 (00:10:50), Teacher 8 (00:12:45), Teacher 9 (00:11:45), Policymaker 6 (00:13:40)*
	Curriculum integration	Embedding AI into math, science, and other content subjects supports meaningful learning and smoother implementation. **Source:** *Principal 11 (00:10:50), Principal 12 (00:12:30), Teacher 9 (00:11:45), Teacher 10 (00:14:10)*
	Online and remote PD access	E-learning and virtual mentorships improve access to AI training for teachers in remote areas. **Source:** *Principal 12 (00:12:30), Teacher 10 (00:14:10), Teacher 11 (00:14:05), Policymaker 6 (00:13:40)*

Theme	Sub-category	Explanation & Source
Best practices	AI for administrative efficiency	AI-assisted tools can automate administrative tasks such as grading and scheduling, allowing teachers to focus more on instructional quality and student engagement. ***Source:*** *Principal 3 (00:12:45), Principal 6 (00:12:55), Teacher 11 (00:14:05), Teacher 12 (00:13:45), Teacher 9 (00:11:45)*
	Personalized learning with AI	AI-powered systems adapt to student pace and level, supporting differentiated teaching and responsive instruction. ***Source:*** *Principal 6 (00:12:55), Principal 9 (00:08:30), Teacher 12 (00:13:45), Teacher 7 (00:11:20), Teacher 10 (00:14:10)*
	AI-focused PLCs	Teacher-led PLCs that explore AI tools and strategies enhance collaboration, peer coaching, and collective problem-solving. ***Source:*** *Principal 8 (00:14:00), Principal 10 (00:12:10), Teacher 12 (00:14:55), Teacher 7 (00:11:20), Teacher 5 (00:14:50)*
	Student engagement through AI tools	Gamified learning environments, AI-based visualizations, and simulations increase student engagement and learning motivation, especially in abstract subjects. ***Source:*** *Principal 5 (00:12:00), Principal 11 (00:10:50), Teacher 6 (00:14:55), Teacher 8 (00:12:45), Teacher 2 (00:11:45)*
	AI-supported assessment and feedback	AI tools provide real-time feedback, adaptive quizzes, and data-informed evaluations, supporting more personalized and efficient assessment. ***Source:*** *Principal 11 (00:10:50), Principal 12 (00:12:30), Teacher 10 (00:14:10), Teacher 8 (00:12:45), Teacher 6 (00:14:55)*

Note: The times indicated next to each source represent the moments during interviews or recordings when these insights were captured.

The authors began with a close reading of every interview transcript and policy document, assigning descriptive labels through independent open coding. Then, after discussing collaboratively, the authors merged overlapping codes and clarified conceptual boundaries before axial coding grouped related concepts under broader themes tied directly to the research questions. In this period, constant comparison between urban and rural cases helped guard against bias to ensure that the developing categories reflected genuine contextual differences or school levels. Wen then refined all themes across several review cycles until the coding framework reached theoretical saturation, with no new concepts emerging.

Furthermore, analytic credibility received further reinforcement through multiple validation techniques. An external analyst, uninvolved in data collection, recoded a subset of materials, and strong convergence in interpretations enhanced confidence in the scheme. The authors actively sought disconfirming evidence, adjusting or nuancing themes whenever contradictions appeared. Triangulation across principals, teachers, policymakers, and documentary sources enhanced rigour, while member checks with selected participants confirmed that the findings resonated with their lived experience. The resulting thematic structure therefore offers a solid foundation for context-sensitive conclusions about AI literacy development in Vietnam's K-12 sector.

Table 2 presents subcategories of AI literacy development for teachers in Vietnam, grouped into challenges, strategies, and best practices. The table shows how infrastructure gaps, funding limits, and teacher preparation issues constrain AI use, while effective programs and professional collaboration enhance readiness, engagement, and assessment quality.

4. RESULTS

4.1. Challenges in Developing AI Literacy for Teachers in Vietnam

There are significant differences in the technological infrastructure between schools in urban and rural areas. Therefore, this divide is hindering the equitable development of AI literacy among teachers in Vietnam's educational context. Schools in urban areas tend to have more reliable internet connections and more advanced digital devices, enabling teachers to engage with AI-based tools or even AI-supported educational platforms. In contrast, schools in disadvantaged areas often lack digital support, sometimes having no internet access or minimal digital devices. Principal 5 noted *"Our school simply does not have the technology needed to fully embrace AI literacy although we are trying*

our utmost. Indeed, we are struggling with basic digital tools, let alone expensive and complex AI tools or AI-supported platforms". The absence of technological support mechanisms after training also prevents teachers in rural regions from integrating AI effectively into their instructional practices. Therefore, without significant efforts to close the digital divide, disparities in access and participation will continue to undermine Vietnam's efforts to promote AI literacy for teachers.

Financial constraints present serious challenges to the adoption of AI in schools, even in areas with better infrastructure. Although more schools in urban areas possess the infrastructure needed for digital learning, limited budgets are still a common problem in acquiring AI-specific tools or organizing sustained teacher training to enhance AI competencies for teachers and students. As teacher 4 explained, *"While we have the infrastructure, our school doesn't have the budget for application of AI-specific tools at an institutional scale or to fund teacher training about the integration of AI in education. Allocating funds for AI-related initiatives becomes extremely difficult when the school's limited budget must already be stretched to meet essential operational needs."* In addition, Ministry of Education data and reports also indicated that AI remains a lower-tier funding priority compared to other educational demands. As a result, schools that are willing to implement AI often find themselves unable to do so due to insufficient financial support.

In K-12 schools, one noticeable barrier is a lack of foundational knowledge about how to integrate AI into teaching practices, especially in rural areas. In fact, many teachers expressed unfamiliarity and discomfort with the ideas of integrating AI tools or platforms. Teachers indicated that they do not have enough AI-related training opportunities or that existing training programs are ineffective. Teacher 9 stated, *"At first, AI seems so foreign to me and many of my school's teachers. We've never had any formal training on AI, and honestly, I feel intimidated to learn something so complex at this point in our careers."* In more and more disadvantaged schools, teachers have been struggling to use AI tools in classroom instruction. However, even in developed urban settings, many teachers remain unsure how to implement AI in meaningful ways due to the lack of well-structured training or ongoing technical support for teachers. The integration of AI in primary education may be even more challenging, given younger students' developmental needs and the limited readiness or unwillingness of early-grade teachers. In addition, teachers also pointed out that the training sessions were too short with insufficient follow-up support. Even worse, some training sessions were conducted by trainers who had strong technical knowledge but limited pedagogical expertise to show how AI can be meaningfully integrated into the classroom.

Misunderstandings about AI's relevance in education may hinder AI integration in disciplines in K-12 schools. In fact, many teachers still consider AI as a specialized domain suitable only for technical subjects like STEM and computer science. When some teachers in humanities and social sciences could dismiss the application of AI as unrelated to their subject matter, meanwhile, some teachers worry AI will affect human agency or have a negative impact on the mental development of students. As policymaker 3 explained, *"There is a misunderstanding that AI is only relevant to those in technical fields. Teachers in social sciences sometimes deem AI technologies as unrelated or negatively contributing to the development of their fields".* Hence, this misconception would create a division between teachers who view AI as essential or positively potential and those teachers who perceive AI technologies as irrelevant. In fact, AI tools can enhance a wide range of educational practices, from personalized instruction to streamlined administrative processes. Expanding teachers' awareness of AI's interdisciplinary potential is essential to achieving broader teacher engagement with AI tools or AI-supported platforms. However, this very same policymaker warned that an even more serious concern is the growing tendency to view AI as a catch-all solution for educational problems, an attitude resembling the techno-solutionism trap in education.

The resistance to AI integration in classrooms might stem from a sense of overload and uncertainty. In Vietnam, many teachers report feeling overwhelmed with existing responsibilities and with the pressure from the implementation of the new national curriculum. Principal 5 commented: *"Many of our teachers feel overwhelmed by the fast development of AI tools or platforms, they feel confused about how to use those tools to support their students. They already have too many responsibilities and adding AI to their teaching practice feels like too much."* Rather than viewing AI as a tool

for instructional improvement, some teachers perceive learning how to use AI tools as an additional burden. This view is seen more in higher-aged teachers. Meanwhile, change fatigue and a lack of clarity about AI integration in instructional practices further reduce teachers' motivation to work with AI tools or platforms. The successful AI integration in K-12 schools also requires professional and emotional support systems to better motivate teachers to navigate this educational transition.

4.2. Strategies for Enhancing AI Literacy

One effective strategy that addresses teacher preparedness and knowledge gaps in the application of AI in education involves designing effective training programs. Several training programs are limited to abstract concepts, while teachers need hands-on and direct guidelines. Practical engagement with AI tools in authentic contexts would foster greater teachers' familiarity with AI integration in instructional practices. In fact, many teachers become more competent in using AI tools or platforms when they see tangible relevance to their instructional daily practices. Therefore, there should be a roadmap that presents a step-by-step progression and offers a systematic foundation for AI-related training programs for teachers. While a program with clear sequential phases would support the development of AI-related competencies, a short module may introduce basic terminology, AI tool selection, and instructional design. A good training framework should be built on teacher needs and capabilities. This roadmap would ensure both novice and experienced teachers can navigate AI-enhanced education in accordance with schools' educational philosophies, curriculum, and missions.

Table 3 shows a training roadmap for the development of AI literacy for teachers in Vietnam, structured into four progressive steps. The table shows how introductory knowledge of AI and prompt engineering provides a foundation, while exploration of AI-supported practices fosters critical evaluation and practical use. At a more advanced stage, lesson design enriched with AI personalization encourages differentiated instruction and collaboration. The roadmap culminates in applications of customized GPT-based tools, chatbots, and agentic systems, emphasizing both efficiency and ethical responsibility in classroom integration.

Table 3. Training roadmap for the development of AI literacy for teachers in Vietnam.

Step	Description	Learning outcomes
Step 1: Basic AI introduction	Introduction & prompt engineering	Develop a foundational understanding of what AI is and how it functions in educational contexts.
		Recognize common misconceptions and limitations associated with AI technologies.
		Understand ethical responsibilities related to AI use, including bias, transparency, and data privacy.
		Gain confidence in communicating with AI tools through effective prompt construction.
		Cultivate a reflective mindset toward the role of AI in teaching and learning.
Step 2: Exploring AI tools	AI-supported instructional practices	Identify instructional tasks and learning scenarios where AI can enhance teaching effectiveness.
		Analyze the strengths and constraints of different AI applications across subject areas.
		Develop skills to critically assess the pedagogical value of AI-supported strategies.
		Practice applying AI functions to teaching tasks in a guided, contextualized environment.
Step 3: AI for learning design	Designing AI-enhanced learning experiences	Plan and design learning experiences that incorporate AI elements to support differentiation and engagement.
		Create lesson components that blend traditional teaching with AI-driven personalization.
		Structure multimedia content and formative assessments informed by AI recommendations.
		Facilitate collaborative and inquiry-based learning with AI support as a cognitive partner.
	Advanced AI tools for instructional support	Design and apply customized GPT-based tools or other alternatives aligned with specific instructional goals and student needs.

Step	Description	Learning outcomes
Step 4: Advanced AI application		Integrate AI chatbots or agentic systems into classroom workflows to assist with content delivery, assessment, and feedback.
		Use AI agents to automate repetitive tasks, freeing time for personalized instruction and mentoring; interpret and respond to learning data generated by AI to support student growth.
		Foster student independence through guided interactions with adaptive AI systems.
		Reflect on the ethical implications of delegating cognitive tasks to AI and maintain professional oversight in AI-supported environments.

The training roadmap for the development of AI literacy emphasizes the history and nature of AI, as well as prompting engineering. A clear understanding of the underlying principles of AI can reduce hesitation among teachers to adopt AI technologies in classroom settings. Teacher 8 shared: *"I had always been intimidated by AI, but after learning how to use prompt engineering effectively for educational purposes, I now feel more confident in utilizing AI tools to streamline my lesson planning and instructional design for students."* Teachers' confidence in applying AI in education increases when they understand the essence of AI. However, teachers from different disciplines tend to engage with AI in different ways. For example, STEM teachers often require training with more technical depth, sometimes including the core logic behind algorithms. Meanwhile, teachers of humanities or social sciences tend to seek approaches that demonstrate how AI tools can support content exploration or diversify student interaction. Teacher 10 explained: *"AI transformed how I approached teaching history. My students can now interact with historical data sets or figures, which has helped to motivate them to participate more in the class."* Additionally, teachers who recognize that AI enhances rather than replaces their pedagogical expertise are more willing to engage with AI tools ethically and responsibly.

Programs that differentiate by subject area, region, and prior experience improve relevance and effectiveness. For example, teachers in remote areas reported higher satisfaction and practical application when training materials reflected their local classroom realities and resource constraints. In addition, the training roadmap also presents opportunities for teachers to explore practical applications of popular AI tools for their subject areas. The AI integration should be aligned with schools' curriculum goals. Classroom learning environments would become more immersive and engaging with the support of AI tools or AI-supported platforms. Teacher 2 noted a marked improvement in students' comprehension after applying AI resources: *"Before using AI in my lessons, students often struggled with abstract concepts. AI-supported simulations or tools have made abstract concepts tangible, and my students are more engaged than before".* The level of student engagement has been improved resulting from visual and interactive content to support conceptual clarity. Teachers become more confident in their instructional design when supported by responsive and subject-relevant AI tools.

In the training roadmap, AI technologies are perceived as tools for purposeful instructional design. Teachers can combine traditional methods with AI-informed differentiated education. AI-generated multimedia content, adaptive assessments, and interactive tasks enhance student engagement while allowing for more tailored instruction. Furthermore, advanced AI applications in education enable teachers to apply customized GPTs, AI chatbots, or even create agentic AI to meet specific instructional needs. However, ethical awareness remains essential throughout the entire training roadmap to ensure that human judgment guides all critical AI-influenced decisions in the classroom.

Curriculum developers for AI training programs hold key positions in supporting AI adoption in schools. Simple and practical teaching materials help guide teachers unfamiliar with digital tools. In addition, teachers also benefit from institutional access to AI-supported tools. Principal 12 observed, "AI-supported systems can track students' progress in real time and have been a game-changer. Teachers can provide students with personalized learning materials or instructions to ensure that no one gets left behind." Meanwhile, policymakers are trying to integrate teachers' AI literacy into continuous professional development programs for teachers.

The professional learning communities (PLCs) centered on the integration of AI in education provide teachers with spaces to sharpen their ways of using AI more effectively. Teachers can develop competencies and gain more confidence in the application of AI in classroom environments through peer interaction and shared experimentation. PLCs also offer platforms for teachers to generate more ideas for classroom AI applications. Teachers have increased opportunities to collaborate in co-creating and developing instructional materials and to refine their understanding through practical engagement. Additionally, networks designed around mutual goals foster continuous improvement. Teacher 12 reflected on participation in a national PLC: *"Being part of a PLC focused on the integration of AI in classrooms has expanded my horizons. The support from peers has been so valuable that I now have much more confidence in using AI tools in my instructional design."* Teachers working together within structured communities are more likely to adopt new practices with greater pedagogical alignment.

Online learning platforms and virtual mentorships offer an important option for delivering AI-focused professional development to teachers. In disadvantaged areas, geographic distance and limited institutional resources lead to limited AI training opportunities. Therefore, digital programs are favored by many teachers, especially in remote or rural areas. One principal noted that virtual training creates professional development opportunities otherwise unavailable for many teachers. Many teachers emphasized the role of online collaboration in developing AI expertise. Peer support via digital PLCs keeps teachers updated with the latest AI applications in education and instructional practices. Meanwhile, a policymaker acknowledged that national strategies for AI competency development must prioritize digital access to ensure inclusivity in AI training efforts. It is also noteworthy that the connection between K–12 schools and universities or EdTech experts can provide teachers with hands-on experience related to the latest AI research in education.

4.3. Best Practices for Developing AI Literacy in Vietnam

The development of AI literacy for teachers in Vietnam requires a comprehensive and carefully coordinated approach. The application of AI in education has created an urgent demand for teachers' AI training programs that reflect both technological and pedagogical elements. The successful implementation of AI literacy enhancement programs depends on three core pillars: targeted training, access to relevant resources, and consistent alignment with the school curriculum. Context-specific training is a foundational best practice. The design of training programs should consider geographic or disciplinary needs. Teachers are likely to seek deeper insights into AI-supported pedagogy. However, many teachers in rural areas need to have initial exposure to fundamental AI concepts and practical tools. Principal 6 indicated: *"Our training program had to be adjusted for our rural teachers, focusing on the basics of AI integration rather than advanced AI-driven systems."*. Therefore, there should be a balance in AI training programs that fosters national coherence without overlooking local needs.

Blended learning models offer an effective solution for teacher professional development to develop AI competencies for teachers. In-person workshops combined with online modules provide both structure and flexibility. Teacher 10 reflected, *"The online modules allowed me to learn at my own pace while still managing my teaching duties, while in-person workshops help me to engage with AI experts."* However, teachers located in remote areas are more likely to lack access to consistent high-quality in-person training on the integration of AI in classroom environments.

Another important aspect of AI training programs is supporting teachers in managing administrative workload through AI tools. Teachers' responsibilities in schools often extend beyond instruction in classrooms. For example, maintaining records and teachers' reporting can consume a significant amount of their time. AI applications in automation can help to relieve teachers of repetitive tasks. Teacher 12 shared: *"Using AI to handle grading and reporting has cut down hours of administrative work, allowing me to concentrate more on lesson planning and student interaction, which I perceive as more valuable for students."* Increased instructional focus allows teachers to direct their energy toward pedagogical innovation and meaningful student engagement to ensure deeper learning for students.

The development of professional learning communities (PLCs) and teacher-driven networks specialized for AI competency development for teachers represent one of the most effective strategies for advancing AI literacy. Teachers frequently enhance their knowledge through collaboration with others of similar interest. PLCs provide an environment in which teachers have more opportunities to exchange practical insights with the integration of AI in practices. Meanwhile, localized or national-level networks might motivate teachers to pursue instructional innovation in their daily teaching practices. Teacher 7 participating in a national PLC reflected, *"Being part of AI-related learning community has expanded my horizons. I've learned so much from other teachers in other parts of Vietnam. They really shared with me a lot of insights on how to integrate AI into our school curriculum and classrooms.* Community-led approaches strengthen teacher autonomy and foster sustained engagement with technological integration.

Continuous professional development requires more than isolated training sessions. Changing AI tools and practices call for long-term access to up-to-date resources and sustained pedagogical support. Opportunities such as workshops, academic conferences, and virtual forums maintain momentum beyond initial exposure. Teachers in geographically isolated areas often depend on online formats to access training and connect with professional peers. Teacher 6 observed, *"In our remote area, we often feel isolated, but these networks have provided us with the support we need to keep up with new developments."* Well-structured support systems would reduce disparities and promote consistent implementation across diverse teaching contexts in Vietnam.

Furthermore, the partnerships between educational institutions and the technology sector are further enriching teachers' AI competency development. In fact, many universities and ed-tech firms are offering AI applied tools for classroom experimentation. The collaboration between those stakeholders creates fertile ground for a better contextual adaptation of AI in education. Teachers benefit from early engagement with evolving AI tools and can provide feedback that influences future improvements. Therefore, an ecosystem that unites research and practice fosters innovation and ensures that teachers can catch up with AI technological development.

Education policy must include AI literacy as a standard component within teacher preparation and ongoing professional development. Widespread implementation depends on equity in access and clarity in expectations. Teachers lacking foundational training risk exclusion from reforms that increasingly depend on AI-enhanced instruction. Policymaker 4 explained, *"We've seen that when AI literacy is formally included in educational policy, teachers are more motivated to develop their AI competencies."* Equipping teachers with AI knowledge remains a necessary condition for preparing students for the AI-driven world.

The best practices for advancing AI literacy in Vietnam's schools include context-specific training contents, reduction of administrative tasks, enhancement of pedagogical innovation, development of collaborative teacher networks, and coherent national policy support. Effective training programs should be tailored to regional and disciplinary needs, which would strengthen teachers' capacity across both urban and rural contexts. AI-powered tools that reduce the burden of routine tasks allow teachers to focus more on instructional design and student engagement. Professional Learning Communities (PLCs) help develop collective learning and instructional innovation, while partnerships with universities and ed-tech providers serve as a bridge between theory and practice regarding the integration of AI in education. Additionally, policy frameworks that embed AI literacy into teacher development systems promote a long-term commitment to the development of teachers' AI competencies.

5. DISCUSSION

A major barrier hindering AI literacy development in Vietnam stems from the unequal level of technological infrastructure between rural and urban schools. Zhao, Wu, and Luo (2022) observed similar conditions in the Chinese education system. Schools in disadvantaged areas often operate without sufficient technological support, which creates fundamental obstacles for AI integration. The different levels of schools' infrastructure across Vietnam also contribute to broader educational inequalities. Many teachers in underserved regions face limited access to digital resources, hence hindering them from integrating AI into classroom practices. As a result, efforts toward

incorporating AI into instructional practice remain minimal. In addition, Sperling et al. (2024) emphasized that inadequate infrastructure has widened the geographic gap in AI literacy. Additionally, this study highlights another significant constraint: insufficient school funding. Interviews with school leaders revealed that there are ongoing struggles in using AI-related tools or platforms and organizing training for teachers. The budgetary restrictions of schools or the provincial government would prevent the sustainable development of AI competencies for teachers. Meanwhile, Faruqe, Watkins, and Medsker (2021) indicated that full realization of AI literacy goals demands financial commitment and targeted investment in both tools and human capital.

Furthermore, a lack of exposure to AI technologies leaves many Vietnamese teachers feeling unprepared for AI integration in the classroom environment. Teachers' unpreparedness also aligns with Sperling et al. (2024) research results, which show that AI literacy is gaining traction globally, however teacher development programs rarely include AI-related content. Likewise, Ng, Leung, Chu, and Qiao (2021) emphasized that this absence of AI-related training hampers teachers' confidence and effectiveness in utilizing AI tools or platforms in schools. In turn, this gap would lead to a limitation in teachers' competencies to teach AI-related content to students. Furthermore, teachers might perceive AI as an added layer of complexity to their already burdensome workload. There is a misperception among teachers that AI only pertains to technical subjects like mathematics and computer science, which contributes to teachers' resistance to integrating AI into instructional practices. Similarly, Allen and Kendeou (2024) observed that misunderstandings could discourage teachers from engaging with AI in fields outside the STEM sciences.

Despite these challenges, several strategies can be more effective in enhancing AI competencies for teachers in Vietnam. A comprehensive training program that combines theory with hands-on experience has been a critical factor contributing to boosting teachers' AI literacy. Li and Zou (2022) suggested that AI literacy programs yield better results when teachers engage in practical applications to implement immediately in classroom environments. In fact, experiential learning can demystify AI concepts and decrease perceived complexities to foster greater adoption of AI in K-12 schools. Furthermore, tailored training programs would provide another valuable approach. This personalized AI training can ensure that teachers of different disciplines or subjects receive instruction relevant to their specific needs. For example, STEM teachers may require training content about machine learning, whereas humanities and social science teachers might prefer training on how AI tools can support providing students with personalized feedback. Zhao et al. (2022). It is recommended that customized training sections allow teachers in all fields to see the relevance of AI literacy in daily instructional practices. Policymakers indicate that embedding AI literacy into schools' existing curricula, rather than treating AI as a separate subject, is a more effective approach. Teachers can integrate AI into lessons to increase students' engagement and improve their studying performance. Allen and Kendeou (2024) advocate for this approach by encouraging teachers to see AI as an enhancement to traditional teaching methods rather than a replacement.

The professional learning communities dedicated to developing teachers' AI literacy are considered an effective way to foster collaboration and sustained learning. As emphasized by Ng et al. (2021), teachers' collaboration is especially important in motivating teachers to integrate AI technologies into instructional practices. The establishment of local-level PLCs would support teachers in developing a culture of AI-related knowledge sharing. In Vietnam, AI-related training programs have been customized for different regions and subjects to provide hands-on experiences for teachers. Vietnamese teachers are in need of online training options. PLCs and collaborative networks serve as continuous support mechanisms for teachers to embrace AI technologies in the classroom environment. In addition, rather than treating AI as a standalone subject, schools should embed AI literacy into the existing curricula. Teachers need resources that highlight AI's cross-disciplinary relevance. School curriculum developers and policymakers should make AI literacy a priority to ensure the effective integration of AI literacy into teachers' AI competencies development efforts. This study highlights ethical awareness as a fundamental element of AI literacy development for teachers. Similarly, Berendt et al. (2020) emphasized that when integrating AI into teaching practices, teachers need to have a code of conduct that goes beyond simple compliance. The development of

technical competencies for teachers must address challenges including privacy, security, and overdependence on AI among students. Therefore, teachers serve as both practitioners and ethical role models for students to follow. In fact, a structured training for teachers with real-world cases and moral inquiry would build the capacity for thoughtful engagement with AI tools or platforms.

Moreover, school leadership plays a central role in advancing AI competencies for teachers. School principals with consistent direction ensure access for teachers of different disciplines. Lack of coordination at the national level would create deeper divides between well-resourced and underserved schools. Meanwhile, a meaningful partnership with universities and educational technology providers will support teachers in updating with the latest AI applications in education. It means that Vietnam should build a strong ecosystem to sustain the development of AI competencies for teachers. Long-term integration of AI in education depends on unified, adaptive leadership.

6. CONCLUSION

This study identified several challenges that affect the development of AI literacy for teachers in Vietnam. The gap in infrastructure, including Internet connection between rural and urban areas, remains a core issue. In fact, schools in advantaged areas can provide teachers with more opportunities to access AI tools or professional development courses focusing on AI. Additionally, many schools in Vietnam operate under restricted funding, which prevents them from integrating AI in classroom settings. Teacher preparedness is another major issue; limited access to AI-related experiences leaves many teachers uncertain about AI integration in classrooms. This study emphasizes the value of a structured design of professional development programs for teachers focusing on AI that connect theory with real-world practice. Some teachers still view AI tools as complex or burdensome. A clear example of good practice in integrating AI in education would enhance teachers' belief in the benefits of AI in their subjects, because subject-specific training also increases relevance in the classroom environment. For example, STEM teachers require more AI-related advanced content, while social science teachers feel more satisfied with training that has less technical content and focuses on supporting the development of student creativity. Meanwhile, online training platforms extend access for teachers in both urban and rural areas. Flexible and inclusive training structures ensure all teachers gain the skills needed for effective AI integration.

AI literacy should be embedded in the existing school curriculum to provide a more positive impact for teachers and students than deeming it a separate topic. Teachers would build stronger AI competencies when professional training programs focusing on AI can enhance their instructional methods and increase students' engagement. The integration of AI in the classroom becomes more effective via subject relevance in the trainings. It is clear that PLCs support many Vietnamese teachers by providing opportunities for collaboration with other teachers to explore more ways of AI integration in classrooms. Partnerships between K-12 schools and universities and/or ed-tech companies introduce new AI-related educational research and AI tools or platforms that have the potential to strengthen instructional design or learning experience design. Additionally, policymakers should place AI literacy within national education priorities. A national approach equips teachers to respond to rapid changes in AI technology. Teachers equipped with AI competencies would lead to a better educational transformation in schools. This study highlights the need for alignment across infrastructure, training, and collaboration to create the conditions for sustainable instructional innovation in the Vietnam context.

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