EMI JOURNAL

Research Article

The current issue and full text archive of this journal is available on Thaijo at:
https://so01.tci-thaijo.org/index.php/emi

Received 2 June 2025 | Revised 2 July 2025 | Accepted 15 July 2025

# Bridging the AI Competency Gap: A Study of Teachers in Thai Private School Using the UNESCO Framework

**Teerat Watanapruksa[1] and Dhirapat Kulophas[2]**

[1,2]Faculty of Education, Chulalongkorn University

*Corresponding Author, e-mail: teerat968@gmail.com

## Abstract

This study aimed to investigate the current and desirable states of AI competency among teachers at a private school in Nonthaburi, Thailand, using UNESCO's AI Competency Framework. The framework encompasses five key dimensions: human-centered mindset, ethics of AI, AI foundations and applications, AI pedagogy, and AI for professional development. The research utilized a descriptive survey method, with data collected from the entire population of educators at the school, comprising 58 participants (50 teachers and 8 school administrators). Data were collected through questionnaires and analyzed using mean scores, standard deviations, and the Modified Priority Needs Index ($PNI_{modified}$). Findings revealed significant competency gaps across all dimensions, with AI pedagogy identified as the most urgent area for development. A one-way ANOVA showed that older teachers reported significantly lower levels of current AI competency than their younger counterparts. These results underscore the need for targeted teacher development programs that address technical, ethical, and pedagogical aspects of AI, while also promoting intergenerational learning to scaffold skills across age groups. The study provides actionable insights for policy and professional development for schools seeking to build a future-ready teaching workforce in the age of AI.

**Keywords:** AI Competency, Teacher Development, UNESCO AI Framework, ASEAN Digital Transformation, Thailand Education

**Introduction**

The rapid advancement of artificial intelligence (AI) is transforming industries and educational landscapes worldwide. The technology is widely applied in various fields across many countries (National Science and Technology Development Agency, 2023). The Future of Jobs Report 2023 highlights the increasing demand for AI skills across industries, emphasizing that AI and big data are prioritized for reskilling and upskilling initiatives from 2023 to 2027 (World Economic Forum, 2023). Similarly in the world of education, AI plays a crucial role in assisting teachers by reducing the time spent on administrative tasks. This allows teachers to dedicate more time to teaching and providing individual attention to students (Reese, 2024). While AI promises personalized learning (Robert, 2024), its effectiveness depends on teachers' ability to integrate these tools pedagogically; a competency gap highlighted in this study. Which leads to the increasing of student's engagement and motivation by transforming the learning experience into something more interactive, personalized, and responsive to individual needs. (Alenezi, 2023) Many teachers find AI tools, such as ChatGPT, to be very accessible and easy to adopt. Though teachers report motivation to adopt AI tools (Al-Mughairi & Bhaskar, 2024), our findings suggest this varies by age, with older educators facing steeper learning curves.

Generative AI can generate new content, such as text, images, music, or video, by analyzing patterns in large datasets (Brynjolfsson et al., 2023). The successful outcome of generative AI clearly demonstrates that ChatGPT is highly interactive and capable of not only maintaining realistic, human-like conversations on a wide variety of topics but also producing convincing, creative content (Baidoo-Anu & Ansah, 2023). Although the evolution of AI is not aimed to replace teachers, they do need to know how to work with and use AI to enhance learning experience. (Robert, 2024). As AI becomes more integrated, preparing workers with relevant skills and training is essential. Many will soon have AI-powered assistants, and they won't need advanced technical expertise to work effectively with them. Comprehensive learning initiatives will support this transition (Accenture, 2024). To expand this, Teacher development must equip educators to function not only technically but also ethically and responsibly within digital environments. This includes a commitment to continuous professional learning, as educators must adapt to new digital tools and innovations continuously (Falloon, 2020).

The importance of teacher development lies in its ability to transform teachers into reflective, continuously learning professionals. This growth not only benefits individual teachers but also elevates the teaching profession, ultimately leading to positive impacts on students and the education system (Evans, 2002). The lack of IT skills can limit a teachers' ability to engage students through interactive and technology-driven methods (Anderson, 2005). Teachers are expected to leverage technology not

just for digital literacy, but to transform learning environments, enabling collaboration and improving student engagement and performance (Schleicher, 2012). This also impact student's career path as the increasing demand for AI skills across industries, emphasizing that AI and big data are prioritized for reskilling and upskilling initiatives from 2023 to 2027 (World Economic Forum, 2024).

The school under this study has a vision of "aiming to develop students to be virtuous, knowledgeable, and happy through student-centered learning, guided by school-based management principles, promoting a culture of learning and technological advancement". Yet, the need to develop AI competency at this School is highlighted by evidence indicating that teachers currently lack sufficient knowledge and experience in AI concepts and applications. This gap in AI understanding limits their ability to effectively integrate relevant digital tools and modern methodologies into the classroom (Baidoo-Anu & Ansah, 2023), which is essential in preparing students for a future where AI will play a significant role (World Economic Forum, 2024). By implementing targeted approaches to build AI competency, the school can empower teachers to deliver a more comprehensive, future-ready education that aligns with emerging technological trends.

Research suggests that age plays a significant role in shaping individuals' digital adaptability and openness to technological innovation. Younger teachers, often described as digital natives, tend to be more familiar with emerging technologies, including artificial intelligence, due to greater exposure during their education and early careers (Kabadayi, 2024). In contrast, older educators may face steeper learning curves, stemming from limited prior experience, reduced confidence, or fewer professional development opportunities in digital contexts (Zawacki-Richter et al., 2019). These generational gaps in technology adoption are especially relevant in the context of AI, which demands both technical fluency and pedagogical integration. While AI competency frameworks exist (UNESCO, 2024), their implementation in Southeast Asian schools, particularly considering age-related inequities, is unstudied. This study addresses that gap by assessing AI skill gaps in a Thai private school and providing insights for similar educational contexts. Consequently, it hypothesizes that teachers of different age groups will report significantly different levels of AI competency, with younger teachers perceiving themselves as more competent than their older counterparts.

**Research objectives**

1. To examine the influence of teacher age on their self-assessment of current AI competency at the school.

2. To determine the gaps between current and desired teacher AI competency across the UNESCO framework dimension in the school.

**Conceptual framework**

Upon reviewing related concepts, theories and literature, two major concepts are underlying the conceptual framework of the study. These two concepts are AI competency and teacher development. The explanation about the two concepts in brief is shown below

AI competency for teachers refers to a comprehensive set of knowledge, skills, values, and attitudes that enable educators to effectively engage with artificial intelligence in both teaching practice and curriculum design. According to UNESCO (2024), AI competency encompasses the ability to critically understand the benefits and risks of AI, promote human-centered and ethical use, and apply AI technologies in ways that uphold privacy, fairness, and responsibility. The framework is structured around five key dimensions: human-centered mindset, ethics of AI, AI foundations and applications, AI pedagogy, and AI for professional development. Expanding on this foundation, Sun et al. (2023) define AI competency as the combination of conceptual understanding, technical expertise, and ethical reasoning necessary to teach AI content effectively, covering areas such as machine learning, AI ethics, and problem-solving with AI tools.

Ng et al. (2023) emphasize that AI competency also includes the ability to collaborate with AI, use it meaningfully in various life domains (e.g., home, workplace, and online environments), and critically evaluate AI systems, making it a crucial twenty-first-century digital literacy. Similarly, Sridam et al. (2024) highlight that teachers' AI competency is reflected in their ability to apply AI to enhance learning outcomes, support personalized instruction, and improve teaching efficiency in digital learning contexts. In the context of K–12 education, Kim and Kwon (2023) stress that AI competency also involves a deep understanding of AI tools and their pedagogical applications, including designing AI-based lessons and addressing the ethical dimensions of AI in classroom settings. Collectively, these perspectives position AI competency as a multi-dimensional and evolving construct that is essential for preparing educators to both teach AI as content and use AI as a tool to transform education responsibly and effectively.

Teacher development refers to the continuous process by which educators improve their knowledge, skills, attitudes, and professional practices. It plays a vital role in enhancing teaching quality and student outcomes (Darling-Hammond et al., 2017). Effective development should be ongoing, collaborative, and closely tied to classroom practice. Beyond acquiring new methods, it also involves

intellectual growth, evolving attitudes, and increased motivation (Evans, 2002). Schleicher (2012) emphasizes that teacher development extends beyond initial training and includes structured support, peer learning, and adaptation to changing educational demands.

The UNESCO AI Competency Framework (2024) is contextually appropriate for the studied school, a private institution in Nonthaburi Thailand whose vision emphasizes developing students to be virtuous, knowledgeable, and happy through student-centered learning, technological advancement, and school-based management. The framework's five components—human-centered mindset, ethics of AI, AI foundations and applications, AI pedagogy, and AI for professional development—align closely with the school's educational direction. In particular, the framework supports the school's mission to enhance teacher expertise in learner-centered instruction through the use of digital platforms, technological tools, innovation, and research. By focusing on both ethical and practical dimensions of AI, the framework enables teachers to build competencies that enhance instructional quality and contribute to the development of future-ready learners.

**Hypothesis**

Teachers of different age groups will report significantly different levels of AI competency, with younger teachers perceiving themselves as more competent than older teachers.

**Methodology**

This research employed a descriptive survey design to assess the current and desirable states of AI competency among teachers at the study school, guided by the UNESCO (2024) AI Competency Framework.

*Sampling Design*

The target population for this study included all teachers and school administrators at a private school located in Nonthaburi Province, Thailand. The sampling method used was total population sampling, as all 58 members of the schoolteachers (50 teachers and 8 administrators) were invited to participate and successfully completed the questionnaire.

*Measurement Design*

The research instrument was an online questionnaire developed based on the five dimensions of the UNESCO AI Competency Framework (2024)

The questionnaire consisting of 1) Demographic information, 2) Self-assessment of the current state of AI competency, 3) Self-assessment of the desirable state of AI competency and suggestions for

development approaches. Each item in Sections 2 and 3 used a five-point Likert scale, ranging from 1 = very low to 5 = very high.

The questionnaire used in this study was developed based on a review of relevant literature, academic books, and previous research studies related to AI competency and teacher development. Key sources included the UNESCO (2024) AI Competency Framework and empirical studies addressing AI integration in educational contexts. To ensure content validity, the questionnaire was reviewed by three experts in educational management. The Index of Item-Objective Congruence (IOC), based on the method proposed by Rovinelli and Hambleton (1977), was employed to assess the clarity, relevance, and consistency of each item. The IOC scores of all items ranged from 0.67 to 1.00, indicating that all items were considered valid and aligned with the research objectives based on expert review. To assess the internal consistency of the questionnaire, Cronbach's alpha was calculated for each AI competency component. The results showed excellent reliability, with alpha values ranging from 0.922 to 0.972 across both present and desired state items.

*Data Collection*

The data collection took place during the school's annual meeting. A QR code linking to the online questionnaire was displayed on the screen for teachers and administrators to access. The researcher also provided a brief explanation of how to complete the questionnaire. Participants were informed that the data would be used for research purposes, and no personal identifiers such as names were collected to ensure anonymity and confidentiality. As the meeting was attended by all teachers and administrators at the school, the study achieved a 100% response rate.

*Data Analysis*

Descriptive statistics were used to analyze demographic data. The Modified Priority Needs Index ($PNI_{modified}$) was calculated using the formula (I – D) / D, where I represents the desirable score and D the current score, to prioritize development needs across the five AI competency components.

Inferential statistics were applied to test for group differences. Specifically, a one-way Analysis of Variance (ANOVA) was conducted to examine differences in current AI competency across age groups. Where significant differences were found, post hoc comparisons were performed using the Least Significant Difference (LSD) method. The LSD test was selected for its higher sensitivity in detecting small but meaningful differences between groups, making it suitable for studies involving a limited number of comparisons.

## Research results

### The result of the analysis of respondent's background.

The study involved a total of 58 respondents, consisting of 50 teachers and 8 school administrators at the study school. In terms of gender, the majority were female (n = 54, 93.1%), with only 4 male participants (6.9%). The largest age group was those above 50 years old (n = 36, 62.1%), followed by ages 40-49 (n = 13, 22.4%), 30-39 (n = 6, 10.3%), and below 30 years old (n = 3, 5.2%).

For educational qualifications, most participants held a bachelor's degree (n = 55, 94.8%), while three (5.2%) held a master's degree.

### The result of comparative analysis by demographic variables

Table 1 presents the mean scores and standard deviations of teachers' current AI competency across different age groups. Teachers under 30 reported the highest mean competency (M = 2.90), while those aged above 50 had the lowest (M = 1.98). A gradual decline in mean scores is observed with increasing age, suggesting a negative correlation between age and self-assessed AI competency.

**Table 1** Descriptive Statistics of Teachers' Current AI Competency by Age Group.

| Age Group | N | M | SD |
|---|---|---|---|
| Below 30 | 3 | 2.90 | 0.78 |
| 30-39 | 6 | 2.73 | 0.35 |
| 40-49 | 13 | 2.72 | 0.79 |
| Above 50 | 36 | 1.98 | 0.79 |

A one-way ANOVA revealed a statistically significant difference in teachers' current AI competency across age groups, $F(3, 54) = 4.739$, $p = .005$. Post hoc LSD tests indicated that teachers aged above 50 had significantly lower mean scores (M = 1.98, SD = 0.79) compared to those below 30 (M = 2.90, SD = 0.78), aged 30-39 (M = 2.73, SD = 0.35), and aged 40-49 (M = 2.72, SD = 0.79). Based on Cohen's (1988) guidelines, the effect size ($\eta^2 \approx .21$) can be considered as large.

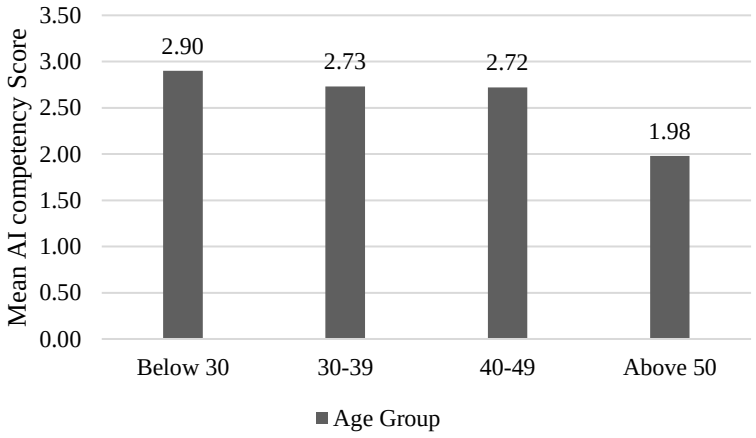


**Figure 1** Teachers' Current AI Competency by Age Group

**The result of the analysis of the present, desirable states and needs of developing AI competency.**

The second research question is aimed to examine the current and desirable states of AI competency development among teachers at the study school using the UNESCO (2024) AI Competency Framework. The framework includes five key components: 1) Human-Centered Mindset, 2) Ethics of AI, 3) AI Foundations and Applications, 4) AI Pedagogy, and 5) AI for Professional Development. The Modified Priority Needs Index was used to determine the gaps between current practice and perceived importance.

**Table 2** The current, desirable states and needs of development of AI Competency.

| AI Competency Component | M (Current) | SD (Current) | M (Desire) | SD (Desire) | $PNI_{modified}$ | Rank |
|---|---|---|---|---|---|---|
| Human-Centered Mindset | 2.34 | 0.41 | 3.47 | 0.35 | 0.48 | 4 |
| Ethics of AI | 2.41 | 0.37 | 3.50 | 0.28 | 0.45 | 5 |
| AI Foundation & Application | 2.34 | 0.38 | 3.55 | 0.32 | 0.52 | 2 |
| AI Pedagogy | 2.36 | 0.28 | 3.61 | 0.23 | 0.53 | 1 |
| AI for Prof. Development | 2.42 | 0.27 | 3.65 | 0.21 | 0.51 | 3 |

Note: N = 58, M = Mean, SD = Standard Deviation, PNI = Priority Needs Index (Modified)

Table 2 presents the descriptive statistics and $PNI_{modified}$ scores for each of the five AI competency components. The component with the highest $PNI_{modified}$ score was AI Pedagogy (0.53), followed by AI Foundations and Applications (0.52) and AI for Professional Development (0.51), indicating these were the most pressing areas of need. Human-Centered Mindset and Ethics of AI scored lower (0.48 and 0.45, respectively), reflecting comparatively smaller perceived gaps. The overall average $PNI_{modified}$ score across all components was 0.50, indicating a moderate level of need for professional development in AI competency among the teachers in the school.

## Discussion

### Influence of Age on AI Competency

The findings provide important support for the hypothesis that older teachers may have lower current AI competency than their younger colleagues. A statistically significant difference was observed among age groups, with post hoc comparisons revealing that teachers aged Above 50 scored significantly lower than those in all younger age categories. This pattern aligns with prior research suggesting that age is a key factor in digital adaptability, where older educators may face greater obstacles due to lower exposure to emerging technologies, reduced confidence, or limited opportunities for formal training (Anzari et al., 2021).

Furthermore, studies related to the TPACK framework have found that age and teaching experience may influence teachers' understanding of technology integration. Older teachers often demonstrate higher scores in pedagogical knowledge (PK) and content knowledge (CK), but lower scores in technological knowledge (TK) (Yue et al., 2024). This suggests age-related gaps in confidence and integration skills.

### Priority Needs of developing AI Competency

The analysis of Priority Needs Index ($PNI_{modified}$) across the five AI competency components revealed clear patterns of priority in teachers perceived development needs. The component with the highest PNI score was AI Pedagogy, followed by AI Foundations and Applications, and AI for Professional Development. In contrast, Ethics of AI and Human-Centered Mindset received the lowest scores, suggesting relatively less perceived urgency.

The ranking of AI Pedagogy as the top priority is consistent with global findings that teachers often feel unprepared to apply AI in instructional contexts Kitcharoen et al. (2024). Studies show that while digital tools may be available, many teachers lack confidence in adapting AI to their teaching

practices, designing AI-enhanced lessons, or assessing student learning through intelligent systems. This highlights the need for development programs that directly address instructional integration.

The second-highest ranked need, AI Foundations and Applications, reflects gaps in teachers' fundamental understanding of how AI works. As Zawacki-Richter et al. (2019) note, many educators have only a superficial awareness of AI, limiting their ability to critically evaluate or make informed decisions about the tools they use. This aligns with the UNESCO framework, which places foundational knowledge at the base of AI competency development (UNESCO, 2024).

On the other hand, Ethics of AI and Human-Centered Mindset received lower PNI scores. This may indicate not that teachers are already competent in these areas, but that they may not yet recognize their importance. Similarly with (Borenstein & Howard, 2021) ethical considerations are often treated as secondary to technical foundations and applications. The low priority assigned to Ethics of AI may reflect a broader trend in teacher professional development programs emphasizing technical skills over ethical reasoning (Holmes & Tuomi, 2022). Future studies should explore whether this stems from limited exposure to AI ethics in training curricula.

**Priority Needs of developing AI Competency**

These findings reinforce the need for teacher development that is both sequenced and holistic. Starting with high-priority areas like pedagogy and foundational understanding, training should gradually incorporate ethical reasoning and human-centered perspectives, as emphasized in AI education research (Holmes & Tuomi, 2022). Scaffolding AI learning in this way ensures that teachers develop not only technical skills but also the critical judgment needed to use AI tools wisely and responsibly in educational settings. Given the finding that younger teachers tend to have stronger AI skills, which also opens opportunities for intergenerational learning, where younger educators can support and scaffold the development of older colleagues, enhancing a collaborative professional culture and ensuring that all teachers regardless of age can confidently integrate AI into their practice.

**Limitations of the study**

Although the research achieved its objectives, this study has certain limitations. First, it was conducted in a single private school, which may limit the generalizability of the findings to other educational settings, such as public schools or schools in different regions. Second, the sample showed a gender imbalance, with a majority of participants being female. This may have influenced the results, as gender-related differences in attitudes or experience with AI tools could affect self-reported competency levels. Future research should aim to include a more diverse range of school types and participant demographics to enhance the validity and applicability of the findings.

This study relies on self-reported data, which may be affected by over- or underestimation, social desirability, or misunderstanding of items. As a result, some teachers' AI competency ratings may not reflect their actual abilities, potentially influencing the accuracy of $PNI_{modified}$ scores. Future studies should consider using objective assessments to support self-report data.

## Recommendations

### Recommendations for practices

Based on the $PNI_{modified}$ results, teacher development initiatives should be aligned with the identified priority order: starting with AI pedagogy, followed by AI foundations and applications, and then AI for professional development. These areas show the greatest perceived gaps between current and desired competency levels. Focusing development efforts in this order ensures that teachers first build the skills most urgently needed for classroom integration, before advancing to broader applications and self-directed professional growth. While ethics and human-centered mindsets scored lower on the PNI, these should still be integrated gradually as foundational understanding and instructional use of AI become more stable. The findings show that teachers over 50 years old reported significantly lower AI competency scores than younger teachers. Development programs should therefore adopt a differentiated approach. Older educators may benefit from more guided, in-person formats like workshops or coaching, whereas younger, more digitally fluent teachers may thrive in self-paced e-learning or collaborative projects. Tailoring delivery methods helps bridge generational gaps and fosters inclusive learning environments. Younger teachers who exhibit higher current competency can serve as peer mentors in coaching systems or Professional Learning Communities. Creating structured opportunities for intergenerational exchange not only enhances professional collaboration but also maximizes existing internal capacity. This promotes a sustainable model for AI knowledge transfer and cultivates a supportive school culture of continuous digital learning. At the policy level, these findings suggest the need to develop and adopt national AI competency standards for teachers in Thailand. A formal framework would provide consistent expectations for teacher training institutions, support school administrators in planning effective development programs, and ensure equity in AI literacy across different types of schools.

### Recommendations for further research

Since this study focused on a single private school in Nonthaburi, broader comparative studies should be conducted across public, rural, and international schools. Such research can help determine whether the UNESCO AI Competency Framework and associated development methods are universally

applicable or require contextual adaptation to address local technological readiness and educational needs.

Although “Ethics of AI” and “Human-Centered Mindset” had the lowest priority needs index scores, this may reflect a lack of awareness rather than true competence. Future research should use interviews, focus groups, or classroom observations to understand how teachers perceive AI ethics and responsibility. These insights could inform the design of more reflective and value-based professional development programs.

Additionally, future studies could further explore the findings through the lens of established frameworks such as TPACK (Technological Pedagogical Content Knowledge), which explains how teachers integrate technology with pedagogy and content. The observed differences across age groups may reflect imbalances in technological knowledge (TK), reinforcing the need to design development programs that address all components of TPACK, particularly for older or less tech-confident educators.

## Conclusion

This study identified significant gaps between the current and desired states of AI competency among teachers at the study school, particularly in the areas of AI pedagogy and foundational understanding. Age was found to be a key factor influencing self-assessed competency, with older teachers reporting lower levels. These findings highlight the urgent need for targeted professional development that is both age-sensitive and competency-specific. The results offer practical insights for schools aiming to build AI readiness among educators in a rapidly evolving digital world.

## References

Accenture. (2024). *Reinvention in the age of generative AI: Report*. https://www.accenture.com/content/dam/accenture/final/accenture-com/document-2/Accenture-Reinvention-in-the-age-of-generative-AI-Report.pdf#zoom=40

Al-Mughairi, H., & Bhaskar, P. (2024). Exploring the factors affecting the adoption AI techniques in higher education: insights from teachers' perspectives on ChatGPT. *Journal of Research in Innovative Teaching & Learning*. https://doi.org/10.1108/JRIT-09-2023-0129

Alenezi, A. (2023). Teacher perspectives on AI-driven gamification: Impact on student motivation, engagement, and learning outcomes. *Information Technologies and Learning Tools*. https://doi.org/10.33407/itlt.v97i5.5437

Anderson, J. (2005). IT, e-learning and teacher development. *International Education*.

Anzari, P. P., Shiddiq, A., Huda, I., Pratiwi, S. S., Fatanti, M. N., & Silvallana, D. F. V. (2021). Teachers Technological Capability as Digital Immigrants in Learning from Home Activities. *International Journal of Emerging Technologies in Learning*, *16*(7). https://doi.org/10.3991/ijet.v16i07.21229

Baidoo-Anu, D., & Ansah, L. O. (2023). Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning. *Journal of AI*, *7*, 52-62. https://doi.org/10.61969/jai.1337500

Borenstein, J., & Howard, A. (2021). Emerging challenges in AI and the need for AI ethics education. *AI and Ethics*, *1*(1), 61-65. https://doi.org/10.1007/s43681-020-00002-7

Brynjolfsson, E., Li, D., & Raymond, L. R. (2023). *Generative AI at work*.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Routledge. https://doi.org/10.4324/9780203771587

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). Effective Teacher Professional Development. *Learning Policy Institute*.

Evans, L. (2002). What is teacher development? *Oxford review of education*, *28*(1), 123-137.

Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency (TDC) framework. *Educational Technology Research and Development*, *68*, 2449-2466. https://doi.org/10.1007/s11423-020-09767-4

Holmes, W., & Tuomi, I. (2022). State of the art and practice in AI in education. *European journal of Education*. https://doi.org/10.1111/ejed.12533

Kabadayi, B. (2024). The Impact of AI on Teacher Identity. https://repositori.urv.cat/fourrepopublic/search/item/TFM%3A1710

Kim, K., & Kwon, K. (2023). Exploring the AI competencies of elementary school teachers in South Korea. *Computers and Education: Artificial Intelligence*, *4*. https://doi.org/doi.org /10.1016/j.caeai.2023.100137

Kitcharoen, P., Howimanporn, S., & Chookaew, S. (2024). Enhancing Teachers' AI Competencies through Artificial Intelligence of Things Professional Development Training. https://doi.org/10.3991/ijim.v18i02.46613

National Science and Technology Development Agency. (2023). *Thailand National AI Strategy*.

Ng, D. T. K., Leung, J. K. L., Su, J., Ng, R. C. W., & Chu, S. K. W. (2023). Teachers' AI digital competencies and twenty-first century skills in the post-pandemic world. *Educational Technology Research and Development*, *71*, 2083-2104. https://doi.org/10.1007/s11423-023-10225-3

Reese, J. (2024). *AI Simplified for Teachers*.

Robert, J. (2024). *AI in Education*.

Rovinelli, R. J., & Hambleton, R. K. (1977). On the use of content specialists in the assessment of criterion-referenced test item validity.

Schleicher, A. (2012). *Preparing Teachers and Developing School Leader for the 21st Century: Lessons from around the World*. OECD.

Sridam, I., Sangkharam, P., & Ittipongse, A. (2024). The Role of Artificial Intelligence Technology in HigherEducation Institutions. *Journal of Education and Innovative Learning*, *4(1)*, 145-159. https://so06.tci-thaijo.org/index.php/jeil/article/view/266447

Sun, J., Ma, H., Zeng, Y., Han, D., & Jin, Y. (2023). Promoting the AI teaching competency of K-12 computer science teachers: A TPACK-based professional development approach. *Education and Information Technologies*, *28*, 1509-1533. https://doi.org/10.1007/s10639-022-11256-5

UNESCO. (2024). *AI competency framework for teachers*. UNESCO. https://doi.org/doi.org/10.54675/ZJTE2084

World Economic Forum. (2023). *Future of Jobs Report 2023* (ISBN-13: 978-2-940631-96-4). W. E. Forum. https://www.weforum.org/publications/the-future-of-jobs-report-2023/

World Economic Forum. (2024). *The global risks report 2024* (978-2-940631-64-3). (World Economic Forum, Issue. https://www.weforum.org/publications/global-risks-report-2024/

Yue, M., Jong, M. S.-Y., & Ng, D. T. K. (2024). Understanding K–12 teachers' technological pedagogical content knowledge readiness and attitudes toward artificial intelligence education. *Education and Information Technologies*, 1-32. https://doi.org/10.1007/s10639-024-12621-2

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal of Educational Technology in Higher Education*, *16*(1), 1-27. https://doi.org/10.1186/s41239-019-0171-0