Korean in-Service Teachers' Perceptions of Implementing Artificial Intelligence (AI) Education for Teaching in Schools and Their AI Teacher Training Programs

Yong-Jik Lee[1], Robert O. Davis[2,*], and Jeeheon Ryu[2]

[1]The Institute of Educational Research, Chonnam National University, Gwangju City, South Korea
[2]Department of Education, Chonnam National University, Gwangju City, South Korea
Email: yongjiklee@jnu.ac.kr (Y.-J.L.); rdavis@jnu.ac.kr (R.O.D.); jeeheon@jnu.ac.kr (J.R.)
*Corresponding author
Manuscript received September 19, 2023; revised October 14, 2023; accepted October 24, 2023; published February 4, 2024

***Abstract*—Previous studies have mostly focused on Artificial Intelligence (AI) education from students' perspectives. However, it is necessary to understand teachers' perceptions of AI convergence education because they are essential personnel for K-12 education. To fill the gap in the literature, this study aims to understand in-service teachers' perceptions regarding AI education for teaching in schools and their AI teacher training programs. Data collection included an online survey (n = 20) and a focus group interview (n = 4). The survey investigated teachers' perceptions of AI education for teaching within the educational setting, while the focus-group interview explored teachers' perceptions of AI teacher training programs. Survey results showed that teachers hold favorable attitudes toward AI education for teaching and future use. The interview findings reveal the advantages and disadvantages of AI teacher training programs. Although most participating teachers expressed satisfaction, there was a notable call for a more practice-oriented curriculum. Specifically, the respondents found that many theory-centric courses failed to offer applicable skills or knowledge for real-world classroom settings. The results from this study have novelty and uniqueness in that understanding teachers' perspectives of AI convergence education for K-12 is essential for teacher education programs. Thus, this study can provide valuable insights and suggestions to structure teacher professional development more effectively in AI convergence education, particularly within diverse higher educational contexts.**

***Keywords*—artificial intelligence, AI convergence education, in-service teachers, teacher training, professional development, Korean higher education**

I. Introduction

With the widespread implementation of online education in elementary and secondary schools across the nation due to the COVID-19 pandemic, there have been heightened expectations for the role of technology in public education [1, 2]. Despite the increased promise of technology, several concerns have been reported in Korean K-12 education. For example, results from online surveys of elementary teachers, students, and parents showed that about 79% of teachers responded that the learning gap has widened due to remote online classes [3], and 74% of parents mentioned that their children's learning needs are not being met through remote online classes. In response to these challenges and gaps in online education, there has been an increased demand for more nuanced, technology-driven learning support, such as individualized learning management systems and diagnostic platforms to correct educational disparities [4]. Various solutions to the educational gap will be proposed, but many believe that educational technology, specifically artificial intelligence, will be the ultimate answer for the future direction of education [5, 6].

Given Korea's rapid technological advancements and a concentrated push towards being a global leader in Artificial Intelligence (AI), the goal to integrate AI into the fabric of education has taken priority by many stakeholders. The current accessibility of AI allows all stakeholders to explore the potential uses of AI technology in education. Since the implementation of AI is early for all in-service teachers, it is important to understand the perceptions of introducing AI technology in certain cultures and provide evidence to understand how AI is considered globally. This research can become part of a body of analysis that helps researchers and designers understand how specific cultures, such as Korea, view the integration of AI into the national curriculum to assess if perceptions might be culturally dependent. Some components to consider with AI integration are understanding how in-service teachers understand AI, how they intend to implement it professionally, and their expectations and concerns when using AI. Thus, this study explored how Korean in-service teachers perceived AI education for teaching in schools and their AI teacher training programs. This study has two research questions.

1) What are Korean in-service teachers' perceptions of AI education for teaching in schools?
2) How do Korean in-service teachers perceive AI teacher training programs at a Korean university?

II. Literature Review

UNESCO's ICT Competency Framework for Teachers is the most well-known teachers' framework for understanding teacher competency [7]. This framework is widely known as a guide for teacher training on using digital technologies for K-12 education. The framework provides key guidelines for which digital competencies can be identified and used to inform ICT in education, curriculum design, and in-service training, as well as support the capacity development of educators to embrace and use technology appropriately in their professional practice.

This framework can also be applied to AI convergence education, including teaching and learning, school administration, and continuing professional development. Implementing the framework for AI education requires enabling a strong environment, including determined leadership from those responsible for teacher education and the professional development of teachers. Thus, exploring

how this framework can apply to AI convergence education that supports the curriculum, assessment strategies, pedagogy, school and class organization, administration, and ongoing professional development is necessary.

Artificial Intelligence (AI) has become increasingly important in education, as it has the potential to revolutionize teacher training programs by providing new tools and resources that can improve teaching and learning outcomes. Although AI has significantly contributed to education by aiding the development of personalized learning, adaptive assessment, and intelligent tutoring systems, its potential in teacher training programs remains largely unexplored.

A few studies have investigated teachers' perceptions of AI education for school teaching. Specifically, these studies have explored teachers' attitudes and perceptions of implementing AI in school education. For instance, Kim *et al.* [8] examined elementary and secondary teachers' perceptions of using AI technology. The results indicated that teachers believed that the integration of AI and big data would have a significant impact on both society and education. Still, implementation should prioritize enhancing students' competencies. Additionally, many teachers were willing to use an AI-based teaching and learning platform as they saw potential benefits, such as personalized classes, reduced administrative tasks, support for struggling students, and improved communication with families. However, teachers also expressed concerns that AI could negatively impact teacher-student interaction, an over-dependence on AI, and the loss of socialization in schools.

Concerning understanding teacher perception of using AI in school sites, Lee [9] assessed elementary teachers' awareness and educational requirements for AI education in practical applications. An online survey was conducted with 110 elementary school and pre-service teachers. The results showed that around 70% of the elementary school teachers had yet to gain experience with AI convergence education, with only 29.1% having experience. In addition, the level of understanding of AI convergence education was lower than the average, with both elementary school and pre-service teachers.

Concerning teacher training programs for AI education, several studies have focused on PCK and their self-efficacy in AI education. For instance, Kim *et al.* [10] conducted a study on using AI in Pedagogical Content Knowledge (PCK) for teacher training. The authors developed an AI-based tool that analyzed teachers' lesson plans and provided feedback on their PCK. This study found that using the AI-based tool improved teachers' PCK and consequently improved student learning outcomes. In another study, Kong *et al.* [11] explored the use of AI in professional development for in-service teachers. The study found that the use of the AI-based system led to improved teacher self-efficacy and improved student learning outcomes.

In a recent study, Pu *et al.* [12] created a module to train Pre-Service Teachers (PSTs) on Artificial Intelligence (AI) through service learning. The study evaluated the effectiveness of PSTs' practical knowledge, motivation, and attitudes toward AI in China. The results showed that the training in the experimental group successfully trained PSTs to teach AI subjects to primary school students and improved their practical knowledge and motivation.

Previous studies have shown how teacher training programs on AI can impact in-service teachers [13]. Several studies have suggested that its potential to enhance teacher training programs through new tools and resources could significantly improve teaching and learning outcomes [14]. Thus, this study explored Korean in-service teachers' perceptions and attitudes toward AI technology to create a field-friendly AI teaching and learning environment.

III. Research Methods

This study used convenience sampling to recruit Korean in-service teachers who agreed to participate in the study. Before the study, the researchers provided consent forms, and all teachers agreed to participate. The teachers were graduate students (Master's degree) in the AI education departments at a university in the Southwest region of Korea. The teacher training programs are intended to re-train Korean teachers to implement AI conference education for their students.

The Master's program consisted of various courses, including teaching methods for AI convergence education, a basic understanding of educational programming, data science using AI, Machine learning, AI ethics, a Capstone design course, and others. The main goal of the curriculum was to understand systematic education on AI convergence education. Also, it aimed to cultivate AI convergence education experts who can develop professional skills necessary for AI convergence education and apply them to the educational field. Based on basic AI literacy, teachers can develop creative problem-solving skills through converging with other subjects' knowledge.

The online survey was conducted during the 2023 Spring semester. Among the survey respondents, 11 were affiliated with elementary schools, 4 with middle schools, and 5 with high schools. Study participants were from educational institutions in urban (n = 12) and rural (n = 8) settings. All participants had substantial teaching experience exceeding six years and possessed prior education and training experience in software (SW) education. The demographic information about the survey respondents is shown in Table 1.

The researchers implemented the survey from Kim *et al.* [7] previously published research. The researchers adopted survey questions as it is. The results are shown in Table 2 below.

The scale's reliability, as indicated by Cronbach's α, ranged from 0.734 to 0.744, suggesting good reliability. Regarding validity, researchers consulted questions with experts via discussions to confirm these questions are appropriate for this study, which aims to understand Korean in-service teachers' perceptions of AI convergence education.

Survey questions were divided into three main areas: the influence of AI technology, the necessary parts and expectations for introducing AI into school education, and school teachers' attitudes and perceptions of an AI-based teaching and learning system.

After the survey, the researchers recruited focus-group interview participants to understand their perceptions of the graduate programs for AI education majors. Four teachers voluntarily agreed to join the focus-group interview. The interview proceeded with Zoom live, and there was no monetary compensation to join the research. Also, their grading for courses remained the same. The interview was

conducted in Korean and lasted about an hour. Table 3 shows focus-group participants' background information.

Table 1. Demographic information of survey participants

Category		Frequency (N = 20)	Percent (%)
School Level	Elementary School	11	55
	Middle School	4	20
	High School	5	25
Workplace Location	Urban area	12	60
	Rural area	8	40
Teaching Experiences	6–10 years	10	50
	11–20 years	10	50
Position	Teacher	14	70
	Head-teacher / Principal	6	30
Participation in Software (SW) Education	Have participated	20	100
	No participation experience	0	0

Table 2. Questionnaire composition and reliability

Category	Number of questions	Cronbach'α
The influence of AI technology	8	0.734
The necessary parts for introducing AI into school education	9	0.744

Table 3. Focus-group interview participants

Teachers	A	B	C	D
School Grade Level	Elementary School	Elementary School	Middle School	High School
Previous AI professional development experience	2	2	3	2
Competency in AI applications	Self-reported as Intermediate level	Self-reported as Pretty confident	Self-reported as Beginner level	Self-reported as Beginner level

For data analysis, we used both quantitative and qualitative methods. Using the SPSS 22.0 program, we conducted technical statistics and frequency analysis. The researchers also conducted a thematic analysis for focus group interview data [15]. Specifically, thematic analysis was conducted via six phrases, including familiar with the data, generating initial codes, searching for themes, reviewing, defining, and writing up. Specifically, the researcher team collaboratively transcribed all the interview data and compared and contrasted interview data with survey responses to see similarities or differences between the two data sources. Also, the research team tried to understand the advantages and disadvantages of AI teacher training programs to suggest future ways to construct effective teacher education programs.

IV. Survey Results

Tables 4 and 5 show the descriptive statistics for the survey. The results include the influence of AI technology, the necessary parts and expectations for introducing AI into school education, and teachers' attitudes and perceptions of AI-based teaching and learning.

Table 4. Descriptive statistics of the influence of AI technology

Category	Question	M	SD
The influence of AI technology	1. AI will change society.	4.60	0.503
	2. AI will be beneficial to society.	4.55	0.510
	3. AI will transform education.	4.60	0.503
	4. AI will be beneficial for education.	4.35	0.489
	5. Big data will change society.	4.65	0.489
	6. Big data will be beneficial to society.	4.25	0.716
	7. Big data will transform education.	4.40	0.821
	8. Big data will be beneficial for education.	4.25	0.716
The necessary parts for introducing AI into school education	1. Lesson planning	4.40	0.733
	2. Formative assessment	3.95	0.887
	3. Performance assessment	4.30	0.470
	4. Individual instruction	4.30	0.979
	5. Classroom instruction	3.90	0.852
	6. Individual learning	4.55	0.510
	7. School curriculum management plan	4.15	0.671
	8. Student counseling	3.20	1.240
	9. Administration	4.20	0.834

Table 5 shows a frequency analysis of the expectations for introducing AI into school education and teachers' attitudes and perceptions of an AI-based teaching and learning system.

Table 5. Descriptive statistics of expectations for implementing AI in schools

Category	Frequency (N=20)		Percent (%)
The expectations for introducing AI into school education	Student Basic Academic Skills Development	7	35
	Escaping Uniform Education	5	25
	Enhancing Student Competencies for the Future Society	10	50
	Enhancing Teacher Professionalism for the Future Society	9	45
	Reducing Teacher Workload	6	30
Intent to Use AI-Based Teaching and Learning Platforms	Have Intension to Use	20	100
	Do not Have the Intention to Use	0	0

The survey indicates that educators held favorable attitudes concerning the use of AI technology. The results are as follows. Most teachers said AI can transform society and education (4.60±0.503). Furthermore, they articulated a robust belief in AI's capacity to yield societal benefits (4.55±0.510), which could benefit educational paradigms (4.35±0.489).

Furthermore, teachers considered the effects of AI technology in conjunction with large data sets. They generally agreed that big data has significant potential for change, viewing it as a powerful influence that can prompt societal progress (4.65±0.489) and alter the educational environment (4.40±0.821).

In this regard, the teachers collectively attributed considerable transformative potential to big data. They viewed it as capable of accelerating societal changes

(4.65±0.489) and drastically altering education (4.40±0.821). This result shared assessment further highlighted the prevailing conviction that incorporating big data offers societal and educational benefits, as indicated by an average rating of 4.25±0.716.

Secondly, an overwhelming majority of educators emphasized the pivotal role of AI technology, assigning exceptionally high levels of effectiveness across various dimensions of the teaching profession. These dimensions included the integration of AI technology in individualized learning (4.55±0.510), lesson planning (4.40±0.733), performance assessment (4.30±0.470), individualized instruction (4.30±0.979), and administrative functions (4.20±0.834).

However, it is important to highlight that there was a marked difference in opinions when evaluating AI technology's efficacy in student counseling. In this context, the ratings showed considerable variability, deviating from the consensus observed in other areas. This variability emphasizes the complex and nuanced nature of educators' views concerning the applicability and effectiveness of AI in the specialized field of student counseling (3.20±1.240).

Thirdly, teachers have expressed optimistic expectations concerning incorporating AI technologies within school education. Notably, a significant proportion (n = 10, 50%) contended that investing in AI technology within the context of school education would not only bolster the readiness of students for the necessities of future society but also enhance the professional competencies of teachers, aligning them more closely with the evolving requirements of future society (n = 9, 45%).

Furthermore, a segment of teachers asserted that the implementation of AI technology holds the potential to significantly enhance students' foundational skills (n = 7, 35%) while concurrently mitigating the workload of educators (n = 6, 30%). These perspectives collectively underscore the prevailing optimism among educators concerning AI technologies' transformative potential within the school education environment.

Ultimately, it is important to highlight that every participant conveyed a pronounced intention to utilize AI-based teaching and learning platforms within educational environments. This result indicates a widespread enthusiasm for integrating AI technologies in future educational settings.

V. Interview Findings

A focus group interview was conducted to in-service teachers' opinions of AI teacher training programs in a Korean university. Several themes emerged about the pros and cons during the interview. Firstly, the benefits of AI teacher training programs included enhanced knowledge and skills in AI applications, created room for the learning community in the school field, the possibility of implementing what they had learned in the classroom, and the benefits of long-term Professional Development (PD) programs. For example, Teacher A mentioned that:

This PD program is government-funded to educate leader teachers in each school district. This kind of opportunity was really good. After graduating, I will return to the field and share my knowledge and expertise with other teachers in the school. The ultimate goal is to build a learning community among teachers, so we will interact to make much more promising lessons that incorporate various AI tools and apps. Kids will like those types of classes.

In addition to this, Teacher C responded that:

I agree with the above teacher's mention. Plus, this program helps us enhance our confidence in AI applications. We often use edu tech tools, but technically, it is hard to say AI-related. The instructors immediately shared various AI tools and apps we could use in the PD program, which was a good strategy.

Another benefit is that the AI training program is two years of the Master's program. Many teachers prefer long-term PD because short-term PD is inconsistent in the learning process. Teacher D pointed out that:

I have joined several short-term PDs during the summer and winter vacations. However, it needed to be constructed with the teacher's technology readiness level. Also, the curriculum needs to be connected. So, after short-term PD, it felt like all the information was gone. I like the long-term PD because I can continue to work on my projects with the instructor's guidance and peer's support.

Secondly, teachers further mentioned some limitations of the AI teacher training programs. Some examples included theory-driven courses that are impractical, policy-related courses that are redundant, and professors who may need more information about the school field. For instance, Teacher B mentioned that:

Some courses that dealt with policies seem redundant. We already know what it is, so that does not have to be repetitive. Also, the theory part could be reduced and replaced with practice applications. We need something in hands-on activities, not the history of AI all the time.

In addition to this, Teacher D mentioned that:

During the lecture, the professors lacked knowledge of the real school field with kids. They said something unrelated to school grade level, and that theory is unrelated to real practice. We like to have senior teachers who know the school field and teach us things we want to learn.

Teacher C finalized the comment that:

Teacher PD for AI is a pretty recent situation. Many teachers use simple edu tech, but AI applications need more advanced knowledge and skills. So, stating now is good, but there is always room for improvement.

VI. Discussion

This study explored Korean in-service teachers' perceptions of AI education for teaching in schools and their AI teacher training programs.

A. What Are Korean in-Service Teachers' Perceptions of AI Education for Teaching in Schools?

Survey results showed that many teachers expressed that integrating AI will significantly impact society and education. Implementing AI education for teaching and learning is important to enhance students' competencies for future

societal roles. Additionally, many teachers are willing to use an AI-based teaching and learning platform as they see its potential benefits, such as personalized classes, reduced administrative tasks, support for struggling students, and improved communication with families.

These results are aligned with previous studies. For example, Kim *et al.* [16] argued that Korean teachers believed AI could transform society and education. Also, most teachers would be willing to adopt an AI-based teaching and learning platform, which could lead to customized lessons for individual students, less administrative burden for teachers, guidance for struggling students, and improved communication with parents. In another study, Hsu *et al.* [17] also argued that teachers recognized the importance of AI education—also the highest educational need for artificial intelligence experiences using diverse platforms. Several previous studies have shown that in-service teachers recognize the importance of AI education for their schools and the need to educate students with proper guidance. Most teachers are aware of the transition period due to AI and agree that AI education is a mandatory requirement for today's technology-advanced society for students.

B. How do Korean in-Service Teachers Perceive AI Teacher Training Programs at a Korean University?

Qualitative interview analysis showed the advantages and disadvantages of AI teacher training programs. The benefits of AI teacher training programs included enhanced knowledge and skills in AI applications, the fostering of a learning community within the educational landscape, the potential of implementing what they had learned in the classroom, and the advantages of long-term PD programs. Although teachers were mostly satisfied with the experience of the program, they expressed a desire for a more practice-oriented curriculum. In other words, many theory-based curricula and courses could not be readily applied to real-world classroom settings. Several suggestions and implications are provided to construct teacher professional development programs for AI education.

These findings align with previous studies that show teacher training programs positively impacted AI education. For instance, Kim and Kwon [18] concluded that teacher PD programs for AI education could benefit teachers by enhancing their self-efficacy regarding pedagogical content knowledge for AI education. Park and Kwon [19] further argued that PD courses for AI education could significantly improve teachers' self-efficacy in teaching AI. These studies have demonstrated several positive impacts of in-service teacher training programs in AI education.

However, previous studies have yet to successfully explore PD programs' limitations for AI education. Thus, this study provides new insights from teachers' perspectives on how teacher educators could successfully construct PD programs for AI education. Also, future studies have explored more on this topic with exploratory research to understand better in-service teachers' diverse experiences of long-term PD programs for AI education.

VII. Conclusions and Suggestions

Effective AI teacher training programs comprise several critical components. Firstly, research on AI teacher training programs incorporating real-world projects into curricula has proven successful. Secondly, AI teacher training programs that allow teachers to apply AI concepts directly in their teaching practice are more effective. Integrating AI training with existing curriculum objectives ensures that teachers can readily apply their learning in the classroom. Lastly, long-term programs that offer ongoing support and resources enable teachers to build AI proficiency continually. In-service teachers' professional development in AI is vital for successfully integrating AI into education. As AI continues to shape the educational landscape, providing teachers with the support and training necessary to leverage AI technologies effectively is imperative. Further research and collaboration between educators and researchers are required to refine and expand AI professional development programs for in-service teachers.

Although this research has several implications for teachers' professional development for AI education, this study has some limitations. First, the participants are 20 Korean in-service teachers at a Korean university. Thus, the survey results from this study cannot be generalized to the whole population. Future research needs to explore more diverse teacher populations and education contexts to understand better the specific context of teacher professional development for AI education. Also, future researchers have to continuously examine teachers' AI teaching competency after professional development to document any changes before and after the teacher training for their ability of AI convergence education. More research will guide several ways of effectively constructing teacher education programs for AI education.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Yong-Jik Lee finished first draft; Robert O. Davis conducted the data collection and analysis; Jeeheon Ryu; editing. All authors had approved the final version.

Funding

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2021S1A5B8096558).

References

[1] C. L. Webb, K. L. Kohler, and R. E. Piper, "Teachers' preparedness and professional learning about using educational technologies during the COVID-19 pandemic," *Journal of Online Learning Research*, vol. 7, no. 2, pp. 113–132, 2021.

[2] K. Zhang and A. B. Aslan, "AI technologies for education: Recent research & future directions," *Computers and Education: Artificial Intelligence*, vol. 2, 100025, May 2021.

[3] B. Kye, H. Kim, Y. Lee, S. Kim, J. Son, and S. Baek, "A study on experience and cognition during remote schooling caused by COVID-19 (GM 2020-11)," *Daegu: Korea Education & Research Information Service*, 2020.

[4] S. Paek and N. Kim, "Analysis of worldwide research trends on the impact of artificial intelligence in education," *Sustainability*, vol. 13, no. 14, p. 7941, July 2021.

[5] J. L. De Vera, M. D. Andrada, A. Bello, and M. G. De Vera, "Teachers' competencies in educational technology integration on instructional methodologies in the new normal," *Lukad: An Online Journal of Pedagogy*, vol. 1, no. 1, pp. 61–80, June 2021.

[6] S. Z. Salas-Pilco, K. Xiao, and X. Hu, "Artificial intelligence and learning analytics in teacher education: A systematic review," *Education Sciences*, vol. 12, no. 8, pp. 1–18, Sep. 2022.

[7] *United Nations Educational, Scientific and Cultural Organization.* "UNESCO ICT competency framework for teachers," 2023.

[8] H. Kim, J. Park, S. Hong, Y. Park, E. Kim, J. Choi, and Y. Kim. "Teachers' perceptions of AI in school education," *Journal of Educational Technology*, vol. 36, no. 3, pp. 905–930, Oct. 2020.

[9] S. W. Lee, "Convergence education of elementary school teachers and pre-service teachers," *Journal of Korean Practical Arts Education*, vol. 34, no. 1, pp. 1–17, July 2021.

[10] S. Kim, Y. Jang, S. Choi, W. Kim, H. Jung, S. Kim, and H. Kim, "Analyzing teacher competency with TPACK for K-12 AI education," *KI-Künstliche Intelligenz* vol. 35, no. 2, pp. 139–151, 2021.

[11] S. C. Kong, M. Lai, and H. T. D. Cheung, "The effectiveness of a teacher development course on artificial intelligence teaching empowerment," presented at the 26th Global Chinese Conference on Computers in Education (GCCCE 2022), Taiwan, China, 2022.

[12] S. Pu, N. A. Ahmad, N. K. Yap, and S. Ahrari, "Improvement of pre-service teachers' practical knowledge and motivation about artificial intelligence through a service-learning-based module in Guizhou, China: A quasi-experimental study," *Asian Journal of University Education*, vol. 17, no. 3, pp. 203–219, July 2021.

[13] AlKanaan, H. M. Nasser, "Awareness regarding the implication of artificial intelligence in science education among pre-service science teachers," *International Journal of Instruction*, vol. 15, no. 3, pp. 895–912, July 2022.

[14] X. Chen, H. Xie, D. Zou, and G. J. Hwang, "Application and theory gaps during the rise of artificial intelligence in education," *Computers and Education: Artificial Intelligence*, vol. 1, 100002, Sep. 2020.

[15] Braun, Virginia, and V. Clarke. *Thematic analysis*. American Psychological Association, 2012.

[16] N. Y. Kim, Y. Cha, and H. S. Kim, "Future English learning: Chatbots and artificial intelligence," *Multimedia-Assisted Language Learning*, vol. 22, no. 3, pp. 32–53, Sep. 2019.

[17] T. C. Hsu, T. P. Hsu, and Y. T. Lin, "The artificial intelligence learning anxiety and self-efficacy of in-service teachers taking AI training courses," in *Proc.2023 International Conference on Artificial Intelligence and Education (ICAIE)*, IEEE, 2023, pp. 97–101.

[18] Kim, Keunjae, and K. Kwon, "Exploring the AI competencies of elementary school teachers in South Korea," *Computers and Education: Artificial Intelligence*, vol. 4, 100137, 2023.

[19] Park, Woongbin, and H. Kwon, "Implementing artificial intelligence education for middle school technology education in the Republic of Korea," *International Journal of Technology and Design Education*, pp. 1–27, 2023.

Copyright © 2024 by the authors. This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited (CC BY 4.0).