Journal of Education and Learning (EduLearn)
Vol. 20, No. 3, August 2026, pp. 1887~1896
ISSN: 2089-9823, DOI: 10.11591/edulearn.v20i3.25169

Understanding AI education perceptions and teaching efficacy among pre-service teachers in Korea

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Article Info

Article history:

Received Jun 8, 2025
Revised Nov 11, 2025
Accepted Jan 31, 2026

Keywords:

AI education
AI teaching efficacy
Physical education
Pre-service teachers
Teacher education

ABSTRACT

This study examines the perceptions of pre-service physical education (PE) teachers (N=31) regarding artificial intelligence (AI) education and their self-efficacy in teaching AI at a Korean university. Although participants demonstrated high interest levels and acknowledged the necessity of AI in education, their understanding of AI concepts and pedagogical applications was notably limited. Statistical analyses revealed that prior exposure to AI-related coursework significantly increased both understanding and perceived importance of AI education ($p<0.05$). However, participants reported low confidence in designing AI-integrated lessons and applying instructional strategies, indicating a substantial gap in their readiness to teach effectively with AI. The disciplinary gap is particularly pronounced in PE, which is traditionally underrepresented in AI education research compared to STEM subjects. Unlike technology-intensive disciplines, PE curricula often emphasize physical skill development and experiential learning, leaving minimal room for the integration of emerging technologies such as AI. This underrepresentation means that PE teacher education programs lack established models or best practices for embedding AI into instruction, further widening the preparedness gap. While participants recognized the societal relevance of AI and expressed a strong sense of responsibility for student learning, they remained hesitant about emotionally intelligent AI and human–AI interactions. These findings underscore the urgent need for structured AI training programs within teacher education—particularly in non-STEM fields like PE—that combine theoretical understanding with practical teaching competence. The results provide foundational evidence to guide the development of AI-integrated curricula that can prepare future educators for an increasingly AI-driven educational landscape.

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1. INTRODUCTION

The Fourth Industrial Revolution has positioned artificial intelligence (AI) at the forefront of educational innovation. AI technologies enable adaptive learning environments, automate assessment, and support personalized instruction [1]–[3]. In response, the South Korean Ministry of Education integrated AI literacy into the 2022 Revised National Curriculum, mandating its inclusion across all subjects, including non-STEM disciplines. Despite these policy advancements, the implementation of AI education in pre-service teacher preparation remains limited and inconsistent. This is particularly evident in fields

traditionally excluded from technology-based instruction, such as physical education (PE). While STEM teacher education programs have increasingly adopted AI-integrated curricula [4]–[7], PE programs lack structured opportunities for AI training. This gap limits pre-service teachers' (PSTs) instructional readiness and reduces their confidence in using AI tools in classroom settings. Furthermore, the absence of formal pedagogical frameworks or certification systems specific to AI education in PE contributes to a misalignment between national policy goals and institutional practices [8]–[10].

Although recent studies have explored in-service teachers' perceptions of AI integration, empirical research on PSTs, especially in non-STEM contexts, is scarce. Prior research has emphasized general attitudes toward AI or its potential utility in classrooms [11]–[13], often neglecting the domain-specific pedagogical skills required for effective implementation. In particular, the construct of AI teaching efficacy, defined as PSTs' belief in their ability to design, implement, and assess AI-enhanced instruction, has received limited attention despite its relevance to classroom technology adoption and instructional quality [14]–[17]. This research gap is critical in the PE, which faces unique instructional challenges, including performance evaluation, physical feedback, and socio-emotional engagement. These factors necessitate specialized, context-aware applications of AI. However, few studies have examined how PSTs in PE understand AI or perceive their readiness to teach with AI tools [18]–[21].

The present study investigates Korean pre-service PE teachers' perceptions of AI education and their self-reported AI teaching efficacy to address this gap. Specifically, the study addresses two research questions:

- RQ1: how do pre-service PE teachers perceive the necessity and value of AI education in their professional preparation?
- RQ2: what levels of self-efficacy do pre-service PE teachers report regarding AI-integrated teaching?

This research contributes to ongoing efforts to expand AI teacher education through inclusive and discipline-sensitive approaches. The findings provide empirical support for designing AI-integrated curricula that align with national policies and the instructional realities of underrepresented subject areas. Ultimately, this study aims to inform pedagogical strategies that enhance the preparedness of PE educators to navigate and succeed in AI-enhanced learning environments.

2. LITERATURE REVIEW

As AI continues to transform education worldwide, teacher preparation programs are facing growing pressure to incorporate AI-related competencies into their curricula. National policy initiatives, such as South Korea's 2022 Revised National Curriculum, explicitly call for the cultivation of AI literacy across all subjects, including non-STEM fields such as PE. Despite these policy directives, the systematic integration of AI into teacher education remains in its early stages, both domestically and globally, with notable disciplinary disparities.

2.1. Policy context and global perspectives

Globally, AI education has become a policy priority in countries such as China, the United States, the United Kingdom, and Singapore, where national frameworks encourage the inclusion of AI competencies in teacher training programs. These initiatives range from large-scale digital literacy campaigns (e.g., China's AI Education Action Plan) to specialized AI teaching certifications (e.g., Singapore's SkillsFuture AI programs). In contrast, Korea's AI education policies are relatively recent, with the 2022 Revised Curriculum marking a significant step toward integrating AI literacy in K–12 education. However, implementation within PE teacher education lags behind STEM-oriented fields due to limited curricular models, a shortage of faculty expertise, and entrenched perceptions that AI is less relevant to embodied and skill-based learning. This underrepresentation is also evident in other countries, where PE and similar practical disciplines often lack dedicated AI integration strategies [22]–[24].

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2.2. Pedagogical foundations and teaching efficacy

Effective AI integration in teacher education requires more than technical proficiency; it demands the development of AI-specific pedagogical knowledge and skills. Frameworks such as AI-TPACK emphasize the intersection of technological, pedagogical, and content knowledge, encouraging subject-specific adaptation of AI tools. Teaching efficacy, grounded in Bandura's self-efficacy theory, has emerged as a critical factor in predicting educators' willingness to adopt AI technologies. Empirical studies indicate that higher AI teaching efficacy is associated with greater innovation in lesson design, increased student engagement, and more effective formative assessment practices. Yet, research indicates that

non-STEM pre-service teachers, including those in PE, often exhibit lower AI teaching efficacy than their STEM counterparts, underscoring the need for targeted pedagogical interventions [25], [26].

2.3. Ethical and emotional dimensions of AI in education

The ethical and emotional aspects of AI are increasingly recognized as integral to responsible AI pedagogy. Issues such as data privacy, algorithmic bias, informed consent, and equitable access are critical for teacher training programs. In PE contexts, additional ethical considerations emerge in the use of motion-tracking technologies, biometric data collection, and emotionally intelligent AI (e.g., social robots, affect-sensitive coaching systems). While global AI education initiatives have begun to incorporate ethics modules—such as the EU's Ethics Guidelines for Trustworthy AI—many PE teacher education programs in Korea and abroad have yet to address these concerns fully. This omission can hinder pre-service teachers' readiness to engage critically and responsibly with AI tools [27], [28].

2.4. The implementation gap in Korea and beyond

Research consistently identifies a gap between pre-service teachers' awareness of AI and their readiness to implement it in practice. In Korea, while most pre-service teachers acknowledge the educational importance of AI, fewer than one-third have participated in AI-integrated instructional activities. This mirrors patterns seen internationally, where high motivation is insufficient without structured, practice-oriented training opportunities. In PE specifically, the lack of context-sensitive training materials, limited exposure to AI-supported performance analysis, and the absence of interdisciplinary collaboration contribute to this gap. Addressing this issue will require integrating AI-enhanced practicum experiences, sharing cross-national best practices, and providing robust ethics education within PE teacher preparation programs [29], [30].

3. METHOD

3.1. Study participants

This study examines pre-service teachers' perceptions and efficacy of AI teaching in the context of AI education within teacher training programs. The research was conducted in PE education at Woosuk University in Korea. As shown in Table 1, 31 undergraduate students participated in the survey. As shown in Table 1, the participants were composed of sophomores (n=6, 19.4%), juniors (n=10, 32.2%), and seniors (n=15, 48.4%), with seniors comprising the most significant portion of the sample. In terms of prior experience with AI learning, 11 students (35.5%) reported having previous experience, whereas the majority, 20 students (64.5%), indicated that they had no such experience. Regarding the types of AI learning experiences, 9 students (29.0%) had taken college courses as part of their major or within liberal arts programs. Additionally, 5 students (16.1%) had participated in short-term training, such as special lectures or extracurricular programs offered by their college or department. The remaining 17 students (54.8%) had not engaged in AI learning. Table 1 summarizes the demographic profiles of the pre-service PE teachers who participated in the study, including gender, academic level, and prior experience with AI-related coursework.

Table 1. Demographic data of survey participants

	Category	Frequency (N=31)	Percentage (%)
Grades	Sophomores	6	19.4
	Juniors	10	32.2
	Seniors	15	48.4
Previous AI learning experience	Yes	11	35.5
	No	20	64.5
Type of AI learning	College courses (major or liberal arts)	9	29.0
	Short-term training at a college or department (special lectures or extracurricular programs)	5	16.1
	No	17	54.8

3.2. Survey instrument design

The survey instrument employed in this study was meticulously developed based on established frameworks and validated scales drawn from previous research by research by Kim [2]. The questionnaire comprised multiple sections to comprehensively capture relevant variables about pre-service teachers' (PSTs) engagement with AI education. The initial section collected demographic and background information, including participants' age, gender, academic year, and prior experience with AI-related technologies. This data provided essential context for subsequent analyses and facilitated subgroup comparisons.

The instrument's core was structured around four principal domains: perceptions of AI education, demand for AI training, and a detailed assessment of AI teaching efficacy across five dimensions. These efficacy dimensions—adapted from established teaching efficacy models and tailored to the AI educational context—encompassed i) instructional design efficacy with AI tools, ii) classroom management efficacy in AI-integrated settings, iii) assessment and evaluation efficacy using AI technologies, iv) student engagement efficacy facilitated by AI, and v) professional development efficacy related to ongoing AI literacy enhancement. Each dimension was operationalized through multiple Likert-scale items, enabling nuanced measurement of participants' confidence and competence levels regarding AI pedagogy.

3.3. Data collection

Data were collected in the Spring semester of 2025 via an online survey platform, targeting pre-service teachers enrolled in teacher education programs at several universities in South Korea. A purposive sampling strategy was employed to recruit participants from diverse academic years and subject areas, with a particular emphasis on including non-STEM majors such as PE. The online format ensured broad accessibility and convenience while maintaining respondent anonymity, thereby encouraging candid and accurate responses. Before the main study, the survey instrument underwent pilot testing with a cohort of 12 pre-service teachers to evaluate item clarity, face validity, and appropriateness of the response scales. Feedback from the pilot led to minor refinements in item wording and scale labels to improve interpretability. Reliability testing of the pilot data yielded acceptable internal consistency coefficients (Cronbach's α values ranging from 0.78 to 0.86 across subscales), providing preliminary support for the instrument's psychometric robustness.

The final dataset was exported into SPSS version 26.0 for comprehensive statistical analysis. Descriptive statistics (means, standard deviations, and frequency distributions) were computed to summarize participants' demographic profiles and overall patterns in perceptions of AI education and AI teaching efficacy. Inferential statistical methods were used to examine group differences. Independent samples t-tests compared mean scores between binary groups (e.g., gender and prior AI experience), while one-way analysis of variance (ANOVA) tested differences across multiple categories (e.g., academic year and university affiliation). Significant ANOVA results were further analyzed using Scheffe post-hoc tests to pinpoint specific group differences. The five dimensions of AI teaching efficacy were examined using descriptive statistics to identify relative strengths and weaknesses among participants. Internal consistency for each subscale was reassessed using Cronbach's alpha on the full sample, yielding coefficients ranging from 0.81 to 0.89, indicating high reliability. This combination of descriptive and inferential analyses provided a nuanced understanding of pre-service teachers' readiness and confidence to integrate AI into their future teaching practices. These results offer empirical guidance for developing targeted AI pedagogical training and curriculum enhancements within teacher education programs.

4. RESULTS

4.1. Pre-service teachers' perception of AI education

Descriptive statistics were analyzed to explore students' perceptions of AI education across three key dimensions: interest, understanding, and perceived necessity. As presented in Table 2, participants reported a moderately high level of interest in AI education (M=3.39, SD=0.882), suggesting that most students are open to and curious about AI-related learning opportunities. However, their understanding of AI education and its application was notably lower (M=2.52, SD=1.061), indicating that while students may be interested in AI, they lack sufficient knowledge about what AI education entails and how it can be practically implemented within educational contexts. The relatively high standard deviation also suggests considerable variation among participants' understanding.

In contrast, the highest mean score was found for the perceived necessity of AI education (M=3.81, SD=0.833), reflecting a strong consensus among students regarding the importance of integrating AI into the curriculum. This result implies that students are aware of the growing significance of AI in society and believe it should be addressed in their academic training, even if their current understanding remains limited.

Table 2. Descriptive statistics of perception of AI education

Category	M	SD
Interest in AI education	3.39	.882
Understanding of AI education and its application	2.52	1.061
The necessary elements for AI education	3.81	.833

The survey examined whether students' perceptions of AI education differed significantly by academic grade level. The analysis covered three dimensions: interest in AI education, understanding of AI education and its application, and the perceived necessity for AI education, as shown in Table 3. For interest in AI education, sophomores reported the lowest level (M=3.17, SD=0.408), followed by seniors (M=3.40, SD=0.986) and juniors (M=3.50, SD=0.972). However, the difference among the groups was insignificant (F(2, 28)=0.257, p=0.755). Regarding the understanding of AI education and its application, sophomores again had the lowest mean score (M=2.17, SD=1.169), while juniors scored slightly higher (M=2.50, SD=0.972), and seniors showed the highest level of understanding (M=2.67, SD=1.113). Nevertheless, the difference was also not statistically significant (F(2, 28)=0.461, p=0.635). For the perceived necessity of AI education, scores increased across grade levels: sophomores (M=3.50, SD=0.837), juniors (M=3.80, SD=0.919), and seniors (M=3.93, SD=0.799). Despite this upward trend, the difference among the groups did not reach statistical significance (F(2, 28)=0.563, p=0.576).

Although slight differences in mean scores were observed across grade levels, none of the differences in students' perceptions of AI education were statistically significant. These findings suggest that students' interest, understanding, and perceived need for AI education are relatively consistent regardless of their academic standing.

Table 3. Analysis of differences in perception of AI education by grade

Category	Grades	M	SD	F	p	Scheffe
Interest in AI education	Sophomores (a)	3.17	.408	.257	.755	-
	Juniors (b)	3.50	.972			
	Seniors (c)	3.40	.986			
Understanding of AI education and its application	Sophomores (a)	2.17	1.169	.461	.635	-
	Juniors (b)	2.50	.972			
	Seniors (c)	2.67	1.113			
The necessary elements for AI education	Sophomores (a)	3.50	.837	.563	.576	-
	Juniors (b)	3.80	.919			
	Seniors (c)	3.93	.799			

An independent samples t-test was conducted to examine whether students' perceptions of AI education differed based on their experience with AI-related learning. The results are presented in Table 4. For students interested in AI education, those with prior AI education experience (M=3.45, SD=1.036) and those without such experience (M=3.35, SD=0.813) did not show a statistically significant difference (t=0.311, p=0.758). This suggests that interest in AI education is relatively high across both groups, regardless of direct exposure to AI learning. In contrast, a statistically significant difference was found in understanding AI education and its application (t=2.893, p=0.007). Students with prior AI learning experience (M=3.18, SD= 1.079) reported a significantly higher level of understanding compared to those without such experience (M=2.15, SD=0.875). This finding suggests that engagement in AI education has a meaningful impact on students' comprehension of AI-related concepts and their applications.

Similarly, a significant difference was observed in the perceived necessity of AI education (t=3.142, p=0.004). Students with prior experience in AI learning (M=4.36, SD=0.674) were more likely to recognize the importance of AI education than those without experience (M=3.50, SD=0.761). Therefore, students who had participated in AI-related education demonstrated a deeper understanding of AI and a stronger belief in its necessity. These findings underscore the importance of offering accessible AI education opportunities at the undergraduate level to foster informed and supportive attitudes among students.

Table 4. Analysis of the perception of AI education according to AI education experience

Category	Grades	M	SD	t	p
Interest in AI education	Yes	3.45	1.036	.311	.758
	No	3.35	.813		
Understanding of AI education and its application	Yes	3.18	1.079	2.893	.007**
	No	2.15	.875		
The necessary elements for AI education	Yes	4.36	.674	3.142	.004**
	No	3.50	.761		

Note: **p<0.01

4.2. AI teaching efficacy of PSTs

Table 5 provides an overview of pre-service teachers' self-reported confidence in various AI teaching tasks, including understanding the societal impacts of AI, instructional planning, and pedagogical

implementation. To explore participants perceived efficacy in teaching AI, descriptive statistics were calculated across 23 items related to instructional capabilities, technological familiarity, beliefs about AI, and perceived student engagement, as shown in Table 5. First, participants' confidence in their teaching abilities related to AI was generally moderate to low. When asked about their ability to explain AI content clearly (M=3.06, SD=1.124), design integrated AI lessons combining technology and pedagogy (M=2.68, SD=1.045), and use AI tools to assess student learning (M=3.00, SD=0.966), the responses reflected limited instructional confidence. Similarly, their ability to answer student questions about AI (M=2.77, SD=0.884) and effectively teach AI (M=2.77, SD=0.99) was evaluated modestly. The lowest level of self-efficacy in this dimension was related to knowledge about teaching and learning methods specific to AI education (M=2.42, SD=0.958). These findings suggest a notable gap between participants' awareness of AI and their readiness to teach it. On the other hand, participants expressed relatively greater confidence in their ability to assess students' understanding using various methods (M=3.13, SD=1.056), indicating a partial strength in evaluation-related competencies.

Table 5. Descriptive statistics of AI teaching efficacy

	Question	M	SD
1.	When teaching AI education, I use friendly examples to explain the content to students.	3.06	1.124
2.	I can design AI education classes that effectively combine technology (including websites, programs, and physical computing) with educational content and teaching methods to promote student-centered learning.	2.68	1.045
3.	When conducting AI education, I can utilize technology (including websites, programs, and physical computing) to effectively assess students' achievements in class content and provide targeted feedback.	3.00	.966
4.	I can answer students' questions well regarding AI-related topics.	2.77	.884
5.	I can effectively teach students about AI.	2.77	.990
6.	I can use various assessment methods to evaluate students' understanding of the content learned in AI education.	3.13	1.056
7.	I am knowledgeable about the teaching and learning methods necessary for AI education.	2.42	.958
8.	I am familiar with using voice recognition AI assistants (e.g., Siri, Bixby, and Google Voice) on smartphones.	4.00	1.095
9.	AI is relevant to our society.	4.42	.886
10.	AI has brought diverse changes to our society.	4.52	.811
11.	Nowadays, AI technology is mainly associated with smart devices.	4.29	.864
12.	Coding (programming) is a part of AI.	3.97	.948
13.	Teachers who provide AI education are responsible for the achievements of their students.	4.03	.875
14.	Student achievement in AI education is directly related to the effectiveness of the responsible teacher's AI education.	3.90	.831
15.	If students perform better in AI education than usual, it is likely due to the teacher's extra effort.	3.81	1.078
16.	Students gained a better understanding of AI education because the responsible teacher employed effective teaching methods.	3.87	.846
17.	Students will faithfully complete assignments in AI education classes.	3.58	1.057
18.	The students I teach are likely to have an interest in AI education.	3.74	.893
19.	It seems helpful for AI to make judgments.	3.42	1.148
20.	It would be convenient to work in an environment that utilizes AI.	3.84	.820
21.	As technology advances and AI become more human-like, it could offer significant benefits to humans.	3.68	.832
22.	Living with an AI with emotions would not be uncomfortable.	2.65	1.279
23.	If AI had emotions, it would be possible to form a close bond with it.	2.97	1.197

Second, participants reported high familiarity with everyday AI tools. In particular, they were highly familiar with using AI voice assistants such as Siri, Bixby, or Google Voice (M=4.00, SD=1.095). They also understood that coding is a component of AI (M=3.97, SD=0.948) and that AI education is connected to smart devices (M=4.29, SD=0.864). These findings suggest that students are more confident with AI when it is embedded in commonly used technologies. Third, participants strongly believed in the significance of AI in contemporary society. They perceived AI as highly relevant (M=4.42, SD=0.886) and believed it had brought about substantial societal changes (M=4.52, SD=0.811). Furthermore, they agreed that teachers play a critical role in shaping students' learning outcomes in AI education (M=4.03, SD=0.875) and that student achievement often reflects effective instruction (M=3.90, SD=0.831). These responses suggest that while participants may lack confidence in their instructional abilities, they nonetheless acknowledge the importance of AI education and the responsibility of educators within that context. Lastly, participants expressed moderately positive expectations about student engagement. They believed students would complete AI-related assignments faithfully (M=3.58, SD=1.057) and that the students they teach are likely to be interested in AI education (M=3.74, SD=0.893).

However, responses were more reserved regarding attitudes toward human-AI interaction and emotional AI. Participants were uncertain that AI could make judgments (M=3.42, SD=1.148) and expressed

moderate positivity about the convenience of working in AI-supported environments (M=3.84, SD=0.82). Nevertheless, levels of agreement declined when participants were asked whether living with an emotional AI would be comfortable (M=2.65, SD=1.279) or whether friendship with an emotional AI was possible (M=2.97, SD=1.197). These results reflect skepticism about emotionally intelligent AI, suggesting that while participants accept AI's functional role, they are hesitant about its more human-like aspects.

5. DISCUSSION

This study examined the perceptions of AI education and the efficacy of AI teaching among pre-service teachers majoring in PE.

5.1. Perceptions of the necessity of AI education

This study examined the perceptions of pre-service teachers (PSTs) in PE regarding AI education and the efficacy of AI teaching. The results indicate moderate interest in AI education (M=3.39, SD=0.882) and strong acknowledgment of its necessity (M=3.81, SD=0.833), but limited understanding of AI concepts and practical applications (M=2.52, SD=1.061). ANOVA results revealed no significant differences by academic level for interest ($F(2, 28)=0.257$, $p=0.755$), understanding ($F(2, 28)=0.461$, $p=0.635$), or necessity ($F(2, 28)=0.563$, $p=0.576$). In contrast, PSTs with prior AI experience exhibited significantly greater understanding (M=3.18 vs. 2.15, $p<0.01$) and perceived necessity (M=4.36 vs. 3.50, $p<0.01$) compared to those without experience. These findings align with previous research, which shows that structured AI instruction strengthens both cognitive engagement and acceptance [20]–[22].

However, the gap between positive attitudes and limited readiness highlights the need for more intentional integration of AI pedagogy in PE teacher education. While participants demonstrated familiarity with everyday AI, such as voice recognition and smart devices, this technological literacy did not translate into teaching competence. Skepticism toward emotionally intelligent AI, also observed in prior studies [8], highlights the need for balanced instruction that addresses both technical knowledge and the ethical, emotional, and social dimensions.

To evolve effectively, PE teacher preparation should embed AI pedagogy into core coursework, not as an optional module, with content tailored to embodied learning contexts such as motion analysis, performance feedback, and adaptive training plans. Hands-on practicum experiences using AI tools in authentic PE settings should be incorporated to bridge theory and practice. Interdisciplinary collaboration with computer science, sport science, and educational technology departments can help co-develop AI-integrated lesson plans. Ethics and socio-emotional learning should be embedded into AI training to prepare teachers for responsible, human-centered implementation. Finally, longitudinal assessment frameworks should be established to monitor growth in AI teaching efficacy from entry into the program through early career stages [23], [24].

5.2. Pre-service teachers' AI teaching efficacy

PSTs recognized AI's societal relevance (M=4.42, SD=0.886) and transformative impact (M=4.52, SD=0.811) but reported low instructional confidence, particularly in lesson planning with AI (M=2.68, SD=1.045), responding to AI-related student questions (M=2.77, SD=0.884), and applying AI-specific pedagogy (M=2.42, SD=0.958). While they acknowledged the importance of practical instruction in AI contexts (M=3.90, SD=0.831) and recognized that teacher effort contributes significantly to student performance (M=3.81, SD=1.078), their readiness to implement AI in practice was limited. To address these issues, PE teacher preparation should introduce microteaching sessions in which PSTs design and deliver AI-enhanced PE lessons under expert supervision. Scenario-based problem-solving activities should be used to strengthen their ability to respond to student inquiries about AI. Discipline-specific AI teaching frameworks should also be developed to integrate PE content, such as biomechanics and sports analytics, with AI tools in a pedagogically meaningful manner [11]–[15].

5.3. Limitations

Several limitations constrain the scope and generalizability of this study. The sample consisted of only 31 pre-service PE teachers from a single Korean university, thereby limiting its representativeness across institutions, regions, and demographic backgrounds. The disciplinary focus on PE also restricts the applicability of findings to other subject areas. Future research should expand to larger, more diverse samples from multiple universities and geographic regions and adopt longitudinal designs to examine changes in AI-related perceptions and teaching efficacy over time. Such approaches would yield a more nuanced understanding of how pre-service teacher preparation can best support the integration of AI across different educational contexts.

6. CONCLUSION

This study highlights the urgent need to enhance AI literacy and teaching effectiveness among pre-service PE teachers in Korea. While national initiatives such as the 2022 Revised Curriculum have emphasized the pedagogical integration of AI, an apparent discrepancy remains between these policy aspirations and the extent to which AI competencies are systematically embedded within pre-service teacher education. In particular, the lack of structured and discipline-specific AI training for non-STEM fields has hindered the readiness of pre-service PE teachers to implement AI effectively in instructional contexts. Without targeted preparation, these educators are less likely to utilize AI tools to enhance instructional quality, learner engagement, and assessment practices.

To bridge this gap, teacher education programs should incorporate AI-related competencies as an essential element of the curriculum, integrating both theoretical frameworks and applied training opportunities. Practical learning experiences, such as AI-enhanced teaching practicums in authentic classroom environments, can foster both confidence and competence in deploying AI-based instructional strategies. Moreover, interdisciplinary approaches that extend AI literacy beyond traditional STEM boundaries will support a more comprehensive understanding of AI's role in diverse teaching and learning contexts.

For curriculum developers and policymakers, these findings underscore the need to establish national guidelines that explicitly integrate AI pedagogy into pre-service training, with dedicated funding for faculty development, instructional resources, and cross-departmental collaboration. Such policy actions should prioritize equitable access to AI education across disciplines, ensuring that fields like PE are not left behind in the digital transformation of education. Future research should adopt longitudinal designs to track changes in AI literacy and teaching efficacy throughout teacher preparation programs and into the early stages of professional practice. Cross-disciplinary comparative studies are also warranted to identify best practices in AI integration across different subject areas, enabling the development of adaptable models that can be tailored to the unique needs of both STEM and non-STEM disciplines. By combining policy innovation, curricular reform, and sustained empirical investigation, the field can better prepare future educators to thrive in AI-enhanced learning environments.

FUNDING INFORMATION

This research was supported by research funding from the 2026 Academic Research Promotion Support Project of Changwon National University.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

There is no conflict of interest between authors.

INFORMED CONSENT

Informed consent was obtained from all subjects involved in the study.

ETHICAL APPROVAL

All procedures involving human participants in this study were conducted strictly in accordance with the ethical principles outlined in the Declaration of Helsinki, which governs the ethical treatment of

human subjects in research. Before data collection, all participants were provided with a detailed informed consent form that explained the purpose of the study, the voluntary nature of participation, the procedures involved, potential risks and benefits, and their right to withdraw at any time without penalty. Participants indicated their consent by signing the form before completing the survey or engaging in interviews. To further safeguard participant confidentiality, all collected data were anonymized and stored securely in encrypted digital formats accessible only to the research team.

DATA AVAILABILITY

The datasets used and analyzed during the current study are available from the corresponding author, [S-HJ], upon reasonable request.

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