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How teachers' AI readiness affects AI integration: insights from modeling analysis

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ABSTRACT

This study examined the dynamic relationships among professional development and training, resources and accessibility, attitudes and perceptions, pedagogical knowledge and expertise, teachers' artificial intelligence (AI) readiness, and the integration of AI in teaching practices. The study employed a non-random purposive approach and utilized the structural equation modeling (SEM) method. Five hypotheses were meticulously formulated and subsequently subjected to empirical scrutiny, involving a cohort of 224 participants. Data were collected via Google Form and subjected to analysis to assess the goodness of fit of the proposed conceptual model. The findings revealed a positive relationship between teachers' AI readiness and the integration of AI in teaching practices. Additionally, attitudes and perceptions, as well as pedagogical knowledge and expertise, exhibited positive effects on teachers' AI readiness. However, the associations between teachers' AI readiness and resources and accessibility, as well as pedagogical knowledge and expertise, were found to be relatively weak and statistically insignificant. The proposed conceptual model accounted for 55.3% of the variance, underscoring the significance of these established relationships for instructors, policymakers, and educators in devising practical intervention strategies to effectively harness the potential of AI.

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1. INTRODUCTION

For over six decades, there has been a significant rise in the prominence and widespread discussion of artificial intelligence (AI) in various media outlets and its integration into our daily lives [1], [2]. AI, which falls under the broad umbrella of computer science, focuses on the creation of intelligent machines that possess the ability to execute tasks typically associated with human intelligence [3]. With its noteworthy attributes including memory retention, autonomous learning, and predictive capabilities, AI has found applications in diverse sectors such as business, entertainment, advertising, tourism, and healthcare [3]–[5]. Undoubtedly, the field of education has also witnessed the influence of AI, generating both positive and negative outcomes [1], [3], [6].

On the positive side, AI is seen as an effective tool for reducing the workload of teachers (e.g., automated grading, providing feedback, creating educational materials) and enhancing the quality of learning for students (e.g., personalized learning, AI virtual teachers) [3], [7], [8]. However, the use of AI also faces several challenges that need to be adequately addressed in the future, such as privacy concerns due to automatic data collection by AI systems, ethical issues (inappropriate use of AI), the accuracy of AI-generated outputs (relying on trained knowledge), and technological and digital intelligence inequalities [9], [10]. One of the challenges in utilizing AI is the technological and digital intelligence divide mentioned earlier. These barriers have received significant attention from researchers aiming to create an equitable environment where AI can be accessible and beneficial for everyone [10]. Various barriers contribute to this inequality, including the lack of necessary technological devices (e.g., sensor-equipped devices for AI functionality), access rights to AI features, knowledge about AI, and practical application of AI [7], [11]. While these barriers may not exist or be significant in developed countries, they are evident in developing nations [12]. To overcome these difficulties, researchers have proposed different solutions, including identifying typical barriers and their corresponding resolutions through comprehensive research [1], [3], implementing training programs to enhance teachers' AI capabilities, applying open AI platforms in educational settings [2], introducing AI education at an early age, and/or building AI competency frameworks. Overall, most AI research in education focuses on the "understanding" and "preparedness for use" of AI [13], while studies on the practicality of AI in education are scarce [7], [11]. This can be partly explained by the aforementioned barriers that make it challenging for many teachers to apply and research AI. As some authors have pointed out, there is a need for more practical research on the use of AI in education to harness its power compared to other domains [1], [3].

Therefore, the purpose of this study is to narrow the research gap by examining the correlation between teachers' readiness to use AI and the actual integration of AI in teaching. The readiness of educators to employ AI involves multiple dimensions, including professional growth and training, availability of resources and accessibility, attitudes, and consciousness, as well as pedagogical knowledge and proficiency. Through a thorough analysis of these interconnections, pivotal determinants can be identified, leading to the provision of tailored intervention strategies and support mechanisms that foster teachers' preparedness for AI integration. Consequently, this endeavor aims to facilitate more efficient implementation of AI technologies within educational contexts. To achieve this goal, this research employs a structural equation model to examine the direct impact of teachers' AI readiness on AI integration. This comprehensive method allows for analyzing complex relationships between latent variables and observed variables, providing a better understanding of the dynamics between teachers' AI readiness and AI integration.

2. PROPOSED CONCEPTUAL MODEL

2.1. Professional development and training

In the context of this study, professional development and training (PDT) refers to the courses and programs offered by institutions to better prepare instructors to implement AI in their classrooms [14]. It focuses on training programs for educators to acquire the necessary skills and knowledge to utilize AI-based resources effectively. Previous research has demonstrated that professional development and training are essential to AI readiness [15]. Akgun and Greenhow [16] highlighted the importance of teacher educators' utilization of digital tools in higher education, emphasizing the subsequent requirement for digital competence. The study revealed that teachers necessitate substantial pedagogical assistance when it comes to developing digital teaching strategies. This study will evaluate the PDT factor using a validated questionnaire based on previous research [17]. The survey will ask respondents how confident they feel in using AI-powered tools after attending the PDT sessions, to what extent the PDT sessions enhanced their knowledge and skills in using AI, and the extent to which the PDT sessions addressed their specific needs and challenges in integrating AI in teaching. On a 5-point Likert scale, teachers will indicate their degree of agreement or disagreement with a number of assertions. The questions are: i) to what extent did the professional development and training sessions enhance your knowledge and skills in using AI? (PDT1); ii) how confident do you feel in using AI-powered tools after attending the professional development and training sessions? (PDT2); and iii) to what extent did the professional development and training sessions address your specific needs and challenges in integrating AI in teaching? (PDT3).

2.2. Resources and accessibility

In the current context, resources and accessibility (RA) refers to the ease with which one can acquire the materials necessary to implement AI-based instructional strategies. It consists of the hardware, including AI-powered tools and technologies, as well as the software and infrastructure required to utilize these tools effectively. Prior research has emphasized the significance of readily available resources to effectively implement an IT system [17]–[19]. For instance, Winter *et al.* [19] examined how teachers' access to resources influences their utilization of technology. Teachers who had access to a wide range of IT tools and technologies were more likely to feel confident in the classroom. Resources and accessibility will be evaluated using a validated questionnaire based on the findings of previous research [17]. The survey will include questions regarding the accessibility and availability of AI technologies. Teachers will be asked to indicate whether they concur with a succession of statements regarding the availability of AI tools, accessibility, and user-friendly. The responses will be compiled using a 5-point Likert scale, allowing educators to indicate the extent to which they concur or disagree with each assertion. The questions are: i) how easily accessible are the necessary technological resources (computers and software) for integrating AI in your teaching practices? (RA1); ii) how sufficient are the available digital resources and materials (e.g., online platforms, educational websites) to support your integration of AI in teaching? (RA2); and iii) how user-friendly are the digital tools and platforms provided to you for incorporating AI into your teaching activities? (RA3).

2.3. Attitudes and perceptions

In this study, the attitudes and perceptions (AP) element refer to teachers' attitudes and perspectives regarding the incorporation of AI into their classroom practices. It attempts to perceive how teachers confident about AI technology, how often they experimenting with new AI technologies, and how important they think teachers should adapt AI technologies in education. Prior research has demonstrated that teachers' beliefs and attitudes have a substantial impact on whether or not they embrace and implement cutting-edge technologies [18], such as AI in the classroom. Previous studies [20], [21] found that those with a more positive outlook on the technology were more likely to implement it. In a similar vein, Sun *et al*. [22] examined educators' perspectives on AI in the classroom and discovered that positive attitudes about AI influenced educators' AI knowledge and teaching skills. In this investigation, the AP variable will be evaluated using a validated questionnaire based on previous research [17], [18]. A 5-point Likert scale will be used to compile the responses, allowing educators to indicate the extent to which they concur or disagree with each statement. The questions are: i) how confident are you in your ability to effectively use AI-powered tools and technologies in your teaching? (AP1); ii) how open are you to experimenting with new AI technologies and incorporating them into your teaching practices? (AP2); and iii) how important do you think it is for educators to adapt to the changing landscape of AI technologies in education? (AP3).

2.4. Pedagogical knowledge and expertise

In the present study, the term pedagogical knowledge and expertise (PKE) pertains to educators' level of familiarity and proficiency in employing pedagogical techniques [23] to effectively integrate AI technology into their classroom practices. It revolves around educators' comprehension of AI tools and applications, as well as their confidence in incorporating these tools and applications into their instructional methodologies. Previous research has consistently highlighted the significance of possessing pedagogical knowledge and expertise when utilizing AI technology in educational settings [16]. Notably, Sun *et al.* [22] examined the relationship between instructors' pedagogical expertise and their utilization of AI technologies. The findings demonstrated that educators with a strong foundation in pedagogical principles were more likely to successfully integrate AI technology into their classrooms. To assess the pedagogical knowledge and expertise construct in this research, the variables will be evaluated using a validated questionnaire based on previous research [23]. The questions are: i) how confident are you in your knowledge of various teaching strategies and techniques? (PKE1); ii) how knowledgeable do you consider yourself in incorporating technology tools into your teaching practices? (PKE2); and iii) how familiar are you with current educational theories and frameworks that inform pedagogical practices? (PKE3).

2.5. Teachers' artificial intelligence readiness

This study conceptualizes teachers' AI readiness (TAR) as the degree to which educators possess the competence and willingness to integrate AI-powered tools into their instructional practices [24]. It encompasses their openness, willingness, and confidence in effectively utilizing AI technology. The level of AI readiness among teachers is of utmost importance as it significantly impacts their motivation and ability to adapt their teaching approaches to incorporate AI applications and tools. Prior research has been conducted to explore teachers' AI readiness in order to gain deeper insights into their attitudes and behaviors towards AI integration in educational settings [25], [26]. For example, Ayanwale *et al*. [25] revealed that the level of confidence in teaching AI was a significant predictor of teachers' intention to teach AI. Additionally, the perceived relevance of AI in education strongly influenced teachers' readiness to implement AI in their classrooms. Drawing on established literature, including the work of [25], a self-report questionnaire will be developed to assess teachers' perspectives on AI and their level of comfort with its implementation in the classroom. The questions are: i) how confident are you in your understanding of AI concepts and technologies? (TAR1); ii) how open are you to incorporating AI tools and technologies into your teaching practices? (TAR2); and iii) how willing are you to learn and acquire the necessary skills to effectively use AI tools in your teaching? (TAR3).

2.6. Integration of artificial intelligence in teaching practices

The integration of AI into teaching practices factor aims to assess the extent to which educators incorporate AI tools and resources into their teaching methodologies. It focuses on the practical application of AI-powered tools and programs to enhance the learning environment and instructional practices. This factor explores how AI is integrated into teaching strategies, lesson plans, and student engagement. Numerous studies have investigated the utilization of AI in educational settings to gain insights into effective strategies, challenges, and outcomes [25], [27]. For instance, Seo *et al*. [27] indicated that participants perceived the adoption of AI systems in online learning as a means to facilitate personalized learner-instructor interaction on a large scale. Moreover, AI systems had received positive recognition for their ability to enhance both the quantity and quality of communication. The AI system was also seen as valuable for providing timely and personalized support in large-scale educational settings. Additionally, the integration of AI systems was believed to improve the overall sense of connection between learners and instructors. In this investigation, the integration of AI in teaching practices (ITP) variable will be evaluated using a validated questionnaire based on previous research [18]. A 5-point Likert scale will be used to compile the responses, allowing educators to indicate the extent to which they concur or disagree with each statement. The questions are: i) to what extent do you incorporate AI tools and technologies in your classroom teaching? (ITP1); ii) how likely are you to continue integrating AI technologies in your future teaching practices? (ITP2); and iii) how often do you collaborate with other teachers to share best practices for integrating AI in teaching practices? (ITP3). Based on the aforementioned studies, the hypotheses were proposed and illustrated in Figure 1: i) professional development and training were a reliable predictor of teachers' AI readiness (H2); ii) resources and accessibility positively influenced teachers' AI readiness (H3); iii) attitudes and perceptions had a statistically significant and positive effect on teachers' AI readiness (H4); and iv) pedagogical knowledge and expertise positively predicted teachers' AI readiness (H5).

3. METHOD

The following subsections provided a detailed description of the processes and procedures. These involved in collecting, measuring, and analyzing the data to evaluate the conceptual research model depicted in Figure 1. They outline the steps taken to ensure reliable and valid data collection, the specific measures used to assess the variables of interest, and the statistical analyses employed to examine the relationships between the variables.

3.1. Research design

This study employed a quantitative research design methodology to investigate the factors that influence university educators' readiness to incorporate AI into their teaching practices. The authors designed a comprehensive training program for university instructors that emphasized the use of AI-powered tools to create multimedia lectures. Three channels were utilized to deliver the training sessions: on-site sessions, Google Meet sessions, and pre-recorded videos. To assure participant familiarity, the authors selected Microsoft PowerPoint Designer, ChatGPT, and text-to-speech from the documented tools available [7]. The training was conducted between June and August 2022, with the intention of conducting a participant survey at the end of the following semester, in December 2022. This methodology is consistent with the best practices recommended in the literature for evaluating the efficacy of professional development programs and measuring teacher satisfaction. The compilation of survey data was completed in April 2023.

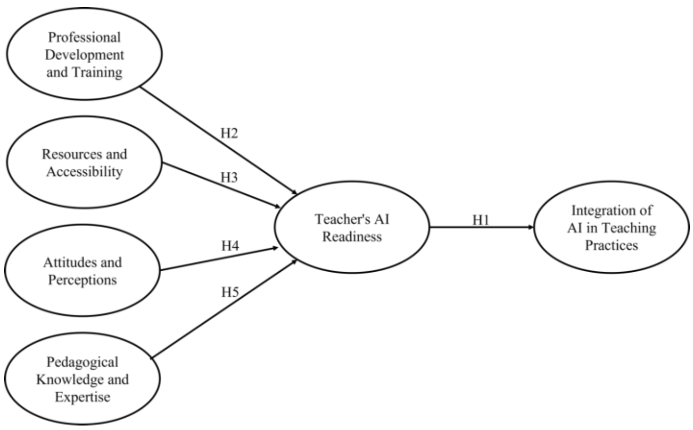

Figure 1. A conceptual model designed to explore predictors of AI integration in educational practices

3.2. Sample and data collection

The current research focuses on university educators residing in the northern mountainous region of Vietnam, which encompasses five provinces and comprises an estimated pool of approximately 500 potential participants. In order to select participants from this readily accessible population, purposive sampling was employed by the researchers. To collect the necessary data, an online survey utilizing Google Forms was administered to the participants. Prior to the survey, participants were provided with comprehensive information regarding the research's objective, data handling procedures, storage methods, data distribution, as well as their right to withdraw from the study at any time. The survey was conducted over a span of four months, specifically from January 2023 to April 2023. The questionnaire utilized in the survey was divided into two sections. The first section aimed to gather demographic information from the participants. The second section consisted of 18 questions assessing the participants' perceptions regarding the integration of AI-powered tools into their teaching practices. To ensure the reliability and face validity of the questionnaire, two field experts with relevant expertise thoroughly analyzed the questions before the survey was distributed to the participants. Any records containing missing or abnormal data were subsequently excluded using listwise deletion, allowing for a cleaner dataset for analysis.

Subsequent to data collection, inappropriate responses were carefully excluded from the analysis to ensure the validity of the findings. This involved the removal of responses with only one option selected (N=121) and those containing missing values (N=27). Consequently, the final sample size utilized for analysis consisted of 224 participants, representing 60.22% of the total responses received (N=372). Literature suggested several recommendations for the sample size, from as small as 100 to few hundreds [28], [29]. In this particular study, the sample size was determined using the recommended tool [30], which suggested a minimum sample size of 200. As the actual sample size in the present study surpassed the recommended threshold of 200, the study met the required criteria for sample size adequacy.

3.3. Data analysis

This study's data were analyzed using R, a statistical programming language, and lavaan, R utility designed particularly for structural equation modeling (SEM) [31]. SEM is a statistical method that permits the examination of intricate relationships between variables and the testing of theoretical models. In particular, partial least squares (PLS) was used to conduct the SEM analysis in this study [32]. First, descriptive statistics were computed to summarize the demographic information collected in the questionnaire's first section. This provided a summary of the participants' characteristics, including age, gender, educational background, and teaching experience. Next, PLS-SEM was used to analyze the responses from the second section of the questionnaire. PLS-SEM is appropriate for exploratory investigations with a comparatively small sample size and permits simultaneous evaluation of the measurement model and structural model [32]. The measurement model was thoroughly assessed to ensure the reliability and validity of the measurement scales before proceeding with the analysis.

4. RESULTS AND DISCUSSION

4.1. Demographic characteristics

Table 1 provides a detailed breakdown of participant characteristics, including gender, age, level of education, and years of experience. In terms of gender, the sample appears to be predominantly female, with 69.2% of the participants being female and 30.8% being male. Examining the age distribution, the majority of participants fall within the 31-40 age range (37.95%), followed by the 41-50 age range (33.93%). The smaller proportions in the 25-30 range (12.05%) and above 50 range (16.07%). Regarding the level of education, the majority of participants hold an undergraduate degree (64.73%), and those with graduate degree holders (35.27%). Analyzing years of experience, the distribution shows a relatively balanced representation across different experience levels. Participants with 11-20 years of experience (25.89%) slightly outnumber those with less than 5 years (31.70%) or 5-10 years (25.45%). However, participants with over 20 years of experience represent a smaller proportion (16.96%).

4.2. Quantitative analysis

The constructs of professional development and training, resources and accessibility, and attitudes and perceptions exhibited satisfactory levels of reliability, as shown in Table 2, with Alpha values ranging from 0.693 to 0.805 and Rho values ranging from 0.803 to 0.885. These results indicate that the items within these constructs consistently measure the intended concepts [32]. Similarly, pedagogical knowledge and expertise, teachers' AI readiness, and integration of AI in teaching practices also demonstrated acceptable levels of reliability, with Alpha values ranging from 0.711 to 0.839 and Rho values ranging from 0.839 to 0.903. These findings suggest that the measurement scales for these constructs exhibit good internal consistency. All constructs exhibited satisfactory levels of convergent validity, with average variance extracted (AVE) values ranging from 0.619 to 0.756. These results suggest that the measurement scales effectively measure the constructs and represent the underlying concepts adequately [32].

Table 3 presents the standardized factor loadings for the latent constructs and their observed indicators. These factor loadings quantify the strength of the relationship between each observed indicator and its corresponding latent construct. A higher factor loading indicates a stronger association between the observed indicator and the latent construct. Starting with the latent construct professional development and training (PDT), all three observed indicators (PDT1, PDT2, PDT3) demonstrate moderate to high factor loadings, ranging from 0.775 to 0.805. These results suggest a significant relationship between the observed indicators and the latent construct of PDT. Moving on to the latent construct resources and accessibility (RA), we find that all three observed indicators (RA1, RA2, RA3) exhibit moderate to high factor loadings, ranging from 0.771 to 0.865. These findings indicate a strong association between the observed indicators and the latent construct of RA. Examining the latent construct attitudes and perceptions (AP), all three observed indicators (AP1, AP2, AP3) display very high factor loadings, ranging from 0.840 to 0.864. This suggests a robust relationship between the observed indicators and the latent construct of AP.

Turning to the latent construct pedagogical knowledge and expertise (PKE), all three observed indicators (PKE1, PKE2, PKE3) demonstrate moderate to high factor loadings, ranging from 0.785 to 0.804. These results indicate a moderate to strong relationship between the observed indicators and the latent construct of PKE. Analyzing the latent construct teachers' AI readiness (TAR), we observe that all three observed indicators (TAR1, TAR2, TAR3) exhibit very high factor loadings, ranging from 0.851 to 0.894. This suggests a strong association between the observed indicators and the latent construct of TAR. Lastly, for the latent construct integration of AI in teaching practices (ITP), all three observed indicators (ITP1, ITP2, ITP3) demonstrate very high factor loadings, ranging from 0.846 to 0.854. This indicates a moderate to strong relationship between the observed indicators and the latent construct of ITP. Overall, the factor loadings indicate that all the observed indicators serve as good measures of their respective latent constructs.

Table 4 provides estimates, standard errors (SE), 95% lower bounds, and upper bounds for four measures: FIT, adjusted FIT (AFIT), the goodness-of-fit index (GFI), and standardized root mean square residual (SRMR). The FIT measure yielded an estimated value of 0.553 (SE=0.0121). The corresponding 95% CI ranged from 0.5296 to 0.5764. Similarly, the AFIT measure had an estimated value of 0.548 (SE=0.0117), with a 95% CI ranging from 0.5252 to 0.5708. These findings suggest that the true values of FIT and AFIT are likely to lie within their respective confidence intervals with a 95% CI level. For the GFI measure, the estimated value was 0.982 (SE=0.0065), and the 95% CI ranged from 0.9695 to 0.9945. This indicates a high level of goodness of fit for the model, as the GFI value approaches 1. Lastly, the SRMR measure yielded an estimated value of 0.061 (SE=0.0134), with a 95% CI ranging from 0.0346 to 0.0874. A lower SRMR value indicates a better fit between the proposed model and the observed data. In summary, the results suggest that the model achieved a favorable fit based on the FIT, AFIT, GFI, and SRMR measures.

Table 1. Participant characteristics in the study sample (N=224)

Variable	Item	No	Percent
Gender	Male	69	30.8
	Female	155	69.2
Age	25-30	27	12.05
	31-40	85	37.95
	41-50	76	33.93
	Over 50	36	16.07
Level of education	Undergraduate	145	64.73
	Graduate	79	35.27
Year of experience	Less than 5	71	31.70
	5-10	57	25.45
	11-20	58	25.89
	More than 20	38	16.96
Total		224	100

Table 2. Reliability and validity of the measurement scales

Construct	AVE	Alpha	Rho
Professional development and training (PDT)	0.619	0.693	0.830
Resources and accessibility (RA)	0.681	0.765	0.865
Attitudes and perceptions (AP)	0.72	0.805	0.885
Pedagogical knowledge and expertise (PKE)	0.634	0.711	0.839
Teachers' AI readiness (TAR)	0.756	0.839	0.903
Integration of AI in teaching practices (ITP)	0.722	0.716	0.839

Table 5 presents path coefficients, standard errors (SE), and 95% confidence intervals (CI) for several proposed relationships. The results reveal the following key findings: Regarding the first relationship (H1), the data shows a statistically significant path coefficient of 0.716* (SE=0.033, 95% CI: 0.659-0.776). This indicates that teachers' AI readiness has a positive influence on the integration of AI in teaching practices. The second relationship (H2) demonstrates a significant path coefficient of 0.2* (SE=0.047, 95% CI: 0.092-0.278), suggesting that PDT have a positive impact on teachers' AI readiness. However, in the third relationship (H3), the path coefficient is 0.101 (SE=0.064, 95% CI: -0.066-0.2), indicating a weak and non-significant association between RA and teachers' AI readiness. The fourth relationship (H4) shows a statistically significant path coefficient of 0.469* (SE=0.063, 95% CI: 0.367-0.622), indicating that AP play a positive role in teachers' AI readiness. Lastly, the fifth relationship (H5) exhibits a non-significant path coefficient of 0.075 (SE=0.057, 95% CI: -0.053-0.181), suggesting that pedagogical knowledge and expertise have a weak and non-significant association with teachers' AI readiness.

Overall, the results indicate that teachers' AI readiness is significantly influenced by their attitudes and perceptions (H4) and the professional development and training they receive (H2). Furthermore, there is evidence supporting the positive impact of teachers' AI readiness on the integration of AI in teaching practices (H1). However, the relationships between teachers' AI readiness and resources and accessibility (H3) and pedagogical knowledge and expertise (H5) are relatively weak and non-significant.

Table 3. Estimates of loadings

	Estimate	SE	95%CI_LB	95%CI_UB
PDT1	0.775	0.028	0.718	0.823
PDT2	0.805	0.023	0.753	0.847
PDT3	0.781	0.029	0.726	0.833
RA1	0.771	0.025	0.723	0.811
RA2	0.838	0.018	0.794	0.875
RA3	0.865	0.016	0.832	0.895
AP1	0.841	0.022	0.782	0.877
AP2	0.840	0.021	0.785	0.876
AP3	0.864	0.017	0.833	0.896
PKE1	0.785	0.027	0.724	0.834
PKE2	0.800	0.032	0.725	0.848
PKE3	0.804	0.028	0.749	0.854
TAR1	0.894	0.016	0.860	0.922
TAR2	0.863	0.017	0.829	0.889
TAR3	0.851	0.024	0.798	0.890
ITP1	0.854	0.018	0.814	0.885
ITP2	0.846	0.023	0.799	0.883
ITP3	0.850	0.021	0.808	0.891

Table 4. Model FIT

	Estimate	SE	95%CI_LB	95%CI_UB
FIT	0.553	0.0121	0.5296	0.5764
Adjusted FIT (AFIT)	0.548	0.0117	0.5252	0.5708
GFI	0.0982	0.0065	0.9695	0.9945
SRMR	0.061	0.0134	0.0346	0.0874

Table 5. Estimates of path coefficients

	Estimate	SE	95%CI_LB	95%CI_UB
TAR → ITP (H1)	0.716*	0.033	0.659	0.776
PDT → TAR (H2)	0.2*	0.047	0.092	0.278
RA → TAR (H3)	0.101	0.064	-0.066	0.20
AP → TAR (H4)	0.469*	0.063	0.367	0.622
PKE → TAR (H5)	0.075	0.057	-0.053	0.181

4.3. Discussion

The purpose of this study was to examine the effects of multi facets on integration of AI in teaching practices. The proposed conceptual model explained 55.3% of the variance in teacher's satisfaction, which indicates a good fit of the data. The results supported three out of five hypotheses. First, regarding H1, the path coefficient of 0.716* indicates a significant positive relationship between teachers' AI readiness and the integration of AI in teaching practices. This finding aligns with previous studies [12], [25] that have highlighted the importance of teachers' readiness in effectively implementing AI technologies in educational settings. The strong positive relationship suggests that as teachers' AI readiness increases, the likelihood of integrating AI in teaching practices also increases [25].

Moving on to H2, the path coefficient of 0.2* indicates a significant positive relationship. This finding is consistent with the literature [33] that emphasizes the role of PDT in enhancing teachers' readiness to adopt and use ICT tools. The positive coefficient suggests that providing effective PDT programs can positively influence teachers' AI readiness. Regarding H3, the path coefficient of 0.101 indicates a non-significant relationship. This finding is somewhat inconsistent with prior research [18], [19] that suggested the availability and accessibility of resources positively impact teachers' readiness. This could be attributed to several reasons. Firstly, participants in the study may have reported a lack of access to essential technological resources, such as AI tools and equipment, which are crucial for developing AI readiness [7]. Insufficient resources can impede teachers' ability to engage with AI technologies and limit their opportunity to develop the necessary skills and knowledge. Secondly, even when resources are available, teachers may encounter technological barriers or face challenges in effectively utilizing AI tools due to technical difficulties or a lack of technical support [7]. Limited accessibility or usability of the resources can diminish their impact on teachers' AI readiness. These findings are consistent with previous research that has highlighted the importance of not only having access to resources but also the necessary support and training to effectively integrate AI in teaching practices [33].

Moving on to H4, the path coefficient of 0.469* indicates a significant positive relationship. This finding aligns with existing literature [20], [21] that emphasizes the influence of AP on teachers' readiness to adopt innovative technologies. The strong positive relationship suggests that positive attitudes and favorable perceptions towards AI technologies can enhance teachers' AI readiness. Finally, for H5, the path coefficient of 0.075 (SE=0.057, 95% CI: -0.053-0.181) indicates a non-significant relationship. This finding is somewhat surprising and differs from previous studies [16], [34] that have highlighted the role of PKE in fostering teachers' readiness for technology integration. This may be attributable to a few factors. First, teachers with extensive PKE may not perceive a direct link between their extant knowledge base and the incorporation of AI into their teaching practices. They may perceive AI as a distinct domain requiring specialized skills and training, which may not align with their existing pedagogical knowledge. In addition, instructors with extensive pedagogical knowledge may have already established effective instructional strategies and be less likely to employ new technologies such as AI. In addition, teachers' lack of exposure to AI-related pedagogical approaches and strategies during their own educational training or professional development programmers may hinder their ability to integrate AI into their instructional practices. These results are consistent with previous research indicating that the integration of AI requires specific training and support to bridge the divide between pedagogical knowledge and the effective use of AI tools in the classroom [33].

4.4. Theoretical and practical implications

The findings of this study have significant theoretical and practical implications. In practice, these implications can aid educational policymakers, administrators, and practitioners in the development of interventions and support systems to enhance teachers' AI readiness and promote the effective integration of AI into teaching practices. First, the findings emphasize the importance of establishing and implementing initiatives to increase instructors' AI readiness through professional development and training. By providing teachers with opportunities for comprehensive and individualized AI technology training, it is possible to increase their readiness to incorporate AI into their teaching practices. The findings also emphasize the need to assist educators in developing positive AI attitudes. By creating a welcoming and supportive classroom environment, a positive attitude toward AI technologies can be promoted. It also demonstrates that assuring adequate availability and accessibility of AI resources may not have a direct impact on instructors' AI readiness, as the study found no significant correlation between resources and accessibility and AI readiness. Instead, experts should consider providing guidance and assistance in using these technologies so that teachers can maximize AI resources in the classroom. Lastly, the absence of a statistically significant relationship between teachers' pedagogical expertise and competence and their AI preparation suggests that additional research is required to identify methods or factors that can bridge this disparity. If educators and policymakers want AI to have the greatest impact on classroom instruction and student learning, they should consider instituting pedagogical techniques and support systems that specifically address the intersection of pedagogy and AI. By contemplating these consequences when establishing targeted interventions and policies to encourage the successful integration of AI in teaching practices, educational stakeholders may enhance the learning experience and outcomes for both instructors and students.

4.5. Limitations

Although this study produced some useful insights, it has some drawbacks that may restrict the usefulness of its findings. The researchers originally targeted teachers in Vietnam's northern regions. Caution must be maintained before projecting the findings to other populations or classroom contexts. Even though the sample size of 224 is greater than the minimum allowable, the results may not be as robust or generalizable as they may be with a bigger sample. Furthermore, self-reported measures were utilized to collect data, which may have response biases or be open to different interpretations. Future study might benefit from a mixed-methods approach or the addition of objective measurements to augment self-reported data. The study is also cross sectional, which means it only gives a single instance of variable relationships. It is feasible to acquire a better understanding of the underlying causal relationships between the components over time by using longitudinal or experimental research approaches. Furthermore, the study focused on a variety of traits related to educators' AI readiness and the usage of AI in teaching practices. Unidentified variables, such as organizational support or external constraints, may have an impact on these relationships. While the study used a conceptual model with established assumptions, it is possible that key components and interactions were overlooked. Future study should look at a wider range of parameters to fully understand the difficulties of instructors' preparedness for and deployment of AI in education.

5. CONCLUSION

This study investigated the relationships between teachers' AI readiness, professional development and training, resources and accessibility, attitudes and perceptions, pedagogical knowledge and expertise, and their impact on the incorporation of AI in teaching practices. Significant positive relationships were identified between teachers' AI preparation and the integration of AI in teaching practices, between professional development and training and teachers' AI readiness, and between attitudes and perceptions and teachers' AI readiness. There was no correlation between resources and accessibility, pedagogical knowledge and expertise, and teachers' AI readiness. These results indicate that teacher preparation is essential for the successful incorporation of AI into teaching practices, highlighting the need for effective professional development and the cultivation of positive attitudes and perceptions toward AI technologies. However, the study had limitations, including its specific context, reliance on self-report measures, cross-sectional design, and focus on particular factors. Future research should address these limitations and investigate additional variables to gain a more comprehensive understanding of instructors' readiness and the incorporation of AI into teaching practices. These findings have practical implications for educational institutions and policymakers, highlighting the need to prioritize professional development and training and cultivate positive attitudes toward AI technologies to facilitate the successful integration of these technologies within educational settings.

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