

Professional Development of Teachers in the Age of AI – An Empirical Study

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Abstract

The impact of artificial intelligence (AI) on education has dramatically changed how educators deliver instruction, plan curricula, assess students, create content, and interact with their learners. The proliferation of AI tools that generate materials have opened doors for educators but require educators to evolve in terms of the way they teach, learn and ethically apply technology, and professionally engage in ongoing AI-based competences. Educators are now required to continuously develop and grow an ever-evolving set of technological skills (e.g., AI literacy), pedagogical competencies (e.g., pedagogy enabled through AI), and professional competencies (e.g., critically evaluating AI generated information). Therefore, educator professional development cannot merely focus on traditional workshops or subject specific training, it must include developing educators' abilities to integrate AI into all aspects of teaching, including AI based pedagogy, digital assessments, data privacy, responsible AI application, and human-centered approaches to education. UNESCO developed an AI Competence Framework for Teachers which defines fifteen (15) competency areas organized across five (5) dimensions: Human-Centred Mindset, Ethics of AI, Foundations & Applications of AI, Pedagogy Enabled Through AI, and Learning & Development Enabled Through AI. This study empirically explores the professional development of educators during this period of rapid transformation due to the integration of AI. The methodological approach utilized included a descriptive/explanatory quantitative research methodology. Data were collected from 118 educators via a structured five-point Likert-type scale survey instrument. Specifically, the study analyzed: Educator AI literacy; Educator AI-based pedagogical competence; Educator ethical awareness regarding AI; Institutional Support of Educator's professional development needs; Educator involvement in professional development relative to AI. Results from the models identified that educators reported moderate levels of AI-based professional development. Furthermore, the importance of strengthening educator's AI-based pedagogical competence and institutional support for professional development was emphasized. Additionally, statistically significant associations existed among educator's AI literacy, educator's pedagogical competence in applying AI, educator's ethical awareness concerning AI, institutional support, and educator's involvement in professional development. Finally, multiple regression analyses suggested that educator's ability to effectively utilize AI within the classroom (pedagogical competence) and institutional support were key factors predicting educator's overall readiness for continuing professional development. Ultimately, this study supports the need for educator professional development in the context of AI to be: Continuous; Practice-Oriented; Ethical; Collaborative; Supported by Educational Institutions

Keywords: Professional Development, AI, Teacher, Literacy, Educational Technology

Introduction

In today's educational landscape, artificial intelligence (AI) represents one of the most significant technological influences shaping education. AI has created applications that have significantly impacted all aspects of education including lesson planning, content creation, assessments, feedback, personalized learning, administrative duties, learning analytics, language translation and professional learning. With the growth of generative AI there will continue to grow the number of activities and processes in which teachers can utilize technology to assist them. As such, the traditional role of the teacher will evolve from providing students with access to information to designing, evaluating, mentoring and critically using digital/technology based learning platforms supported by AI (Gupta, P., et.al., 2026).

Although AI may change how teachers teach and what they do, it does not diminish the significance of having well-trained, competent educators. In fact, the increased presence of AI in classrooms necessitates that teachers become highly skilled professionals. While teachers need to know how AI systems work, when to apply these systems, how to evaluate AI generated material, how to protect student data and how to integrate AI into the classroom while maintaining human authority. Lifelong professional learning is essential for ensuring that teachers continuously learn about new technologies and methods for utilizing those technologies. Therefore, as we transition toward incorporating more AI into our schools, professional development programs will need to shift away from being focused primarily on discrete topics or short-term experiences toward longer term and ongoing opportunities for professional growth. Similarly, the Additionally, it lists twenty-two specific competences and views continuous digital professional development as an integral part of an educator's overall competence.

Research has shown that AI-related professional development is becoming a major area of investigation. Recent systematic reviews indicate that while there was considerable amounts of research conducted on using AI in classrooms (examining its application in teaching), relatively little research examined the potential contributions of AI to teacher professional development (Shelar, R., 2025). Therefore, there is a strong need for empirical studies that investigate the specific needs of teacher professional development related to AI competencies and other factors that influence a teacher's willingness to develop their AI-related competencies. Therefore, this current study seeks to contribute to our understanding of the professional development of teachers in the age of AI by investigating the relationships among three variables: AI-related competencies, institutional support for teacher professional development, involvement in professional development and teacher overall professional development readiness.

Background of the Study

AI will fundamentally shift how teachers teach because it is changing instruction in all the areas of what a teacher does (planning, materials, assessments, communications, and decisions). As such, teachers are encountering ever-increasing amounts of AI-supported tools that include generative text tools, automated assessment tools, adaptive learning platforms, recommendation systems, translation tools, learning analytics, and AI-assistants for education. As AI is becoming an even larger part of education, there are a number of professional requirements being placed upon teachers (Sharma, N., 2017). First, teachers require AI literacy. This includes having a general knowledge of basic AI concepts, its capabilities, limitations, applications, and potential risks. Second, teachers require AI pedagogical competence. This means the ability to incorporate AI into their instruction and learning in a meaningful way. Third, teachers require ethical competence (Choudhary, et.al., 2019). This involves addressing issues of privacy, bias, transparency, copyright, academic integrity, and responsible use (M., N. K, 2025). Finally, teachers require institutional support. Examples of this include providing them with training; supporting their technical infrastructure; establishing the appropriate policies; providing them with technical assistance; and facilitating collaborative opportunities. Similarly, recent empirical studies have supported the value of developing a multi-dimensional level of teacher competence when considering teacher AI literacy. For example, Younis recently developed and tested an Artificial Intelligence Literacy Scale using data from 292 teachers from six different countries. He identified nine factors of competence related to AI, demonstrated the need for assessing teacher AI competence for purposes of both professional development and policy. Researchers have indicated that professional development should be individualized or tailored. Specifically, a 2024 systematic review of teacher

AI training noted that teacher motivation was a major obstacle to implementing effective AI training programs. Therefore, researchers recommend creating AI training programs that motivate, are customized to meet the needs of each individual teacher, and involve hands-on experience.

Related Literature

The article by Aljemely (2024), examines the obstacles and best ways to train teachers how to apply Artificial Intelligence in education. The study indicates that there is a necessity for professional development that has been organized well, sufficient institutional help, practical training and awareness of ethics to reinforce teachers' potential to utilize AI successfully in their teaching/learning practice. The review found out that a constant and contextualized type of training is needed to increase teachers' level of AI literacy and pedagogical ability. A systematic review by Almasri (2024) was performed on empirical research about the influence of artificial intelligence upon the teaching and learning of science. According to this study AI can be used for supporting students in achieving tailored learning experiences, improving the way they learn from scientific inquiries, providing them with intelligent feed-back, and increasing their participation in learning activities. Furthermore the review pointed out that it is crucial for teachers to have technological and pedagogical abilities so that they will be able to teach responsibly and effectively utilizing AI supported methods for instructing. In Caena & Redecker's (2019) study, the alignment of teacher competence frameworks with the challenges in 21st century education were examined, especially via the European Digital Competence Framework for Educators (DigCompEdu). The authors emphasize that teachers require digital competence as well as pedagogical competence, competence in assessing, communication, and professional competence related to continuing education in order to react adequately to technological progress. This study is of significant theoretical interest for understanding teacher digital competence and for enabling them to act in AI enabled educational systems.

Teacher Professional Development Characteristics: Darling-Hammond, Hyler, & Gardner (2017) analyzed the characteristics of effective Teacher Professional Development. They found that such professional development would be most effective if it involved active learning; collaboration; was prolonged; focused on content; coherent; provided teachers with many opportunities for receiving feedback and reflecting over their practices. In addition, their analysis shows that professional development is most effective when it connects with teachers' actual practices within their classrooms, thus providing numerous possibilities for ongoing implementation. As such these findings are highly relevant to AI based Teacher Development since here too practical and long-term learning is called-for instead of one-off technical training. Effects of Teachers' AI Literacy: Du et al. (2024) studied empirically the consequences of Teachers' AI Literacy in their Learning. The results indicate that teachers who possess knowledge, skills and self-confidence concerning the utilization of Artificial Intelligence will better be able to deal with AI-based learning, and consequently decide more consciously about possible uses of AI in Education. These results support the position that AI-Literacy has to develop into an important part of today's Teacher Professional Development Programs.

EU DIGCOMP-Edu: The European Commission, Joint Research Center (2017) published the DIG-COMP-EDU framework which describes the educators' digital competences in detail. This framework includes aspects like "professional engagement", "digital resources", "teaching and learning", "assessment", "empowering learners" and "facilitating learners' digital competences". The EU-DIGCOMP-EDU framework represents a solid basis for analyzing teachers' digital capabilities and offers several interesting perspectives for discussing the necessary capabilities to facilitate successful AI-integration in Education. The Li et al. (2025) systematic review of approaches to incorporating artificial intelligence into teacher professional development programs was based on an adapted version of a technology-based learning model. The review highlights the importance of developing teacher professional development programs around teachers' actual needs for learning, technological readiness, pedagogical requirements, and opportunities to apply what they have learned in practical ways. The results of this systematic review indicate that technology-supported professional development may be associated with improved teacher capacity to incorporate artificial intelligence into instructional practice.

In a recent systematic review of how educators teach artificial intelligence in K-12 classrooms, Liu and Zhong (2024) identify common approaches to teaching AI, key pedagogies, learning goals, and challenges. In addition

to demonstrating the increasing importance of teaching about artificial intelligence in schools, the results of this systematic review suggest that educators require both knowledge about artificial intelligence and knowledge about how to teach it appropriately. Furthermore, the authors conclude that teacher competency will be an essential requirement for successfully implementing and utilizing AI in K-12 education environments. Developed by Miao and Cukurova (2024), the UNESCO AI Competency Framework for Teachers is a comprehensive collection of competences required for teachers in today's AI-driven world. These competences include a human-centered approach; ethics of AI; foundational and applied aspects of AI; AI in the pedagogy of teaching and learning; and AI for teacher professional growth. The framework is an important resource for developing teacher training programs and evaluating teachers' AI-related competences internationally.

Based on an analysis of previous literature reviews on artificial intelligence in education, Mustafa, Tlili, and Lampropoulos (2024) developed a roadmap for future research in the area. While the authors acknowledge the expanding number of applications of AI in education, their synthesis also illustrates persistent areas of concern regarding the pedagogy of AI; the ethics of AI; the preparedness of teachers to utilize AI; methods of assessment of student performance when utilizing AI; and ensuring responsible implementation of AI. The authors emphasize the necessity for future research to focus on examining both teacher competences and professional development, along with technological innovation. Presented by Redecker (2017), the Digital Competence Framework for Educators, often referred to as DigCompEdu, represents an EU-developed framework outlining digital competence as a vital aspect of modern-day teaching professionalism. DigCompEdu establishes progressive levels of competence and focuses on educators' abilities to select digital tools; create learning experiences; assess learner progress; foster learner independence; and enhance their own professional digital competence. The competency-based nature of DigCompEdu serves as a helpful basis for assessing educator preparedness for emerging technologies such as AI. Proposed by Sathya and Alamelu (2026), SmartPD represents a design-based research model intended to increase teachers' digital competence relative to the DigCompEdu framework. SmartPD emphasizes the use of systemic professional development to connect digital competence development with teachers' current practical educational needs and ongoing professional growth. As such, the authors demonstrate the continued shift away from traditional professional development and toward structured, technology-enhanced models of professional growth that assist in increasing educators' digital capabilities. Developed by Younis (2025), the Artificial Intelligence Literacy (AIL) Scale for teachers enables researchers and practitioners to evaluate educators' knowledge and competence in regards to AI. Recognizing that evaluating educators' AI literacy will enable researchers and practitioners to understand educators' professional learning needs and whether or not they are ready to employ AI within educational settings, the AIL Scale assists researchers and practitioners in developing more methodically assessed evaluations of teacher AI literacy and providing evidence-based planning for educators' professional development.

Examining new research avenues in artificial intelligence in education, Zhong and Liu (2024) describe the evolving requirements for educators' competences. Based on emerging research, these authors illustrate that educators who seek to employ AI must expand upon their technical skills so that they are capable of employing AI-supportive pedagogy; critically analyzing AI; making ethical decisions concerning AI use; and responsibly utilizing AI in the classroom. Therefore, Zhong and Liu reinforce the significance of educators having well-rounded competency frameworks applicable in the AI environment. Presenting the UNESCO (2024) AI Competency Framework for Teachers as an international framework for developing teacher preparation and professional development in an AI-driven world. The framework includes competences related to human-centered utilization of AI; ethics; knowledge and applications of AI; AI-pedagogy; and professional learning. The framework has been designed to serve as a universally relevant foundation for organizations and policy-makers to develop teacher development programs focused on promoting effective, ethically-responsible, and socially responsible AI utilization. According to reports from the European Commission (2026), updates to the DigCompEdu framework are currently being explored due to rapidly emerging technological advancements in the form of artificial intelligence and other similar technologies as well as changes in educational needs. Such updates reflect the increased importance of such technologies as artificial intelligence and ensure that educators' digital competence frameworks continue to remain relevant to contemporary educational practice. Such developments

demonstrate the continuously-evolving nature of teacher competency requirements and increasingly-integrated AI-related competences into professional development frameworks.

Statement of the Problem

The rapid expansion of Artificial Intelligence (AI) has resulted in an increasing gap between what educators can do with AI and how well-prepared educators are to work with AI. While educators are increasingly expected to utilize AI-based learning tools as part of their teaching practice, most professional development programs still focus on educating educators about "digital literacy" (i.e., the basic skills that one needs to function in today's technology-rich world), instead of focusing on providing educators with specific knowledge regarding AI, as well as knowledge about integrating AI into their classroom practices; developing teachers' ability to critically evaluate and make ethically-sound decisions when using AI. Therefore, the issue addressed by this research was determining the current state of teachers' professional development related to AI and identifying the major variables that contribute to teachers' preparation to develop and implement their own competencies and abilities related to AI.

Table 1: Research (Objectives & Hypothesis)

Sr. no.	Research Objectives	Hypothesis Code	Research Hypothesis
1.	To assess the level of professional development of teachers in the age of Artificial Intelligence.	H01	There is no significant relationship between AI literacy and teachers' professional development.
2.	To examine teachers' level of AI literacy and AI pedagogical competence.	H02	There is no significant relationship between AI pedagogical competence and teachers' professional development.
3.	To assess teachers' ethical awareness regarding the use of AI in education.	H03	There is no significant relationship between ethical awareness and teachers' professional development.
4.	To examine the role of institutional support in teachers' AI-related professional development.	H04	There is no significant relationship between institutional support and teachers' professional development.
5.	To determine the relationship between AI literacy, AI pedagogy, ethical awareness, institutional support, professional development participation and overall professional development.	H05	There is no significant difference in teachers' professional development according to gender.
6.	To examine differences in teachers' professional development according to selected demographic variables.	H06	There is no significant difference in teachers' professional development according to teaching experience.
7.	To determine the significant predictors of teachers' professional development readiness in the age of AI.	H07	AI literacy, AI pedagogical competence, ethical awareness, institutional support and professional development participation do not significantly predict teachers' professional development readiness.

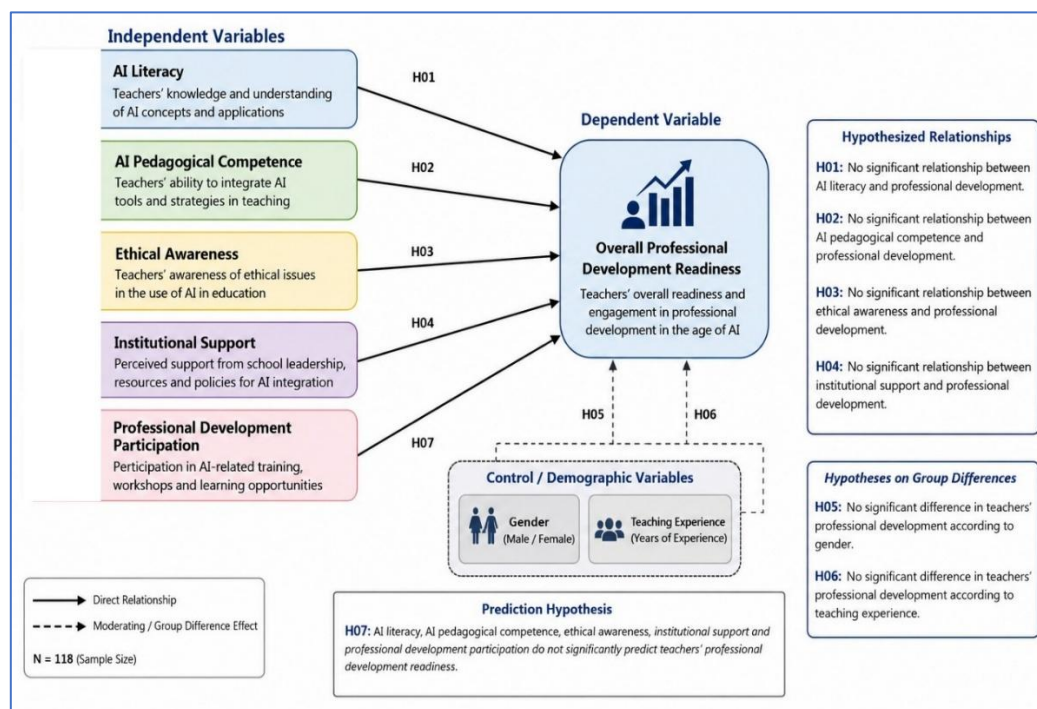


Figure 1: Conceptual Research Model

Research Methodology

The researcher used an explanatory and descriptive quantitative research methodology for this study. The descriptive component of the methodology was intended to measure the levels of professional development concerning AI that were experienced by the teachers. The explanatory component was intended to determine if there are any predictive effects or causal relationships between the various variables under study. A population of all teachers at educational institutions constituted the population for this study. Therefore, based on this criterion, a total sample of 118 teachers was selected for inclusion in the empirical analysis. In order to calculate sample size (N), $N=118$. A purposeful/convenient sampling method was deemed suitable for this study as it involved selecting teachers with experience utilizing digital technology and/or knowledge of how AI is utilized in educational settings.

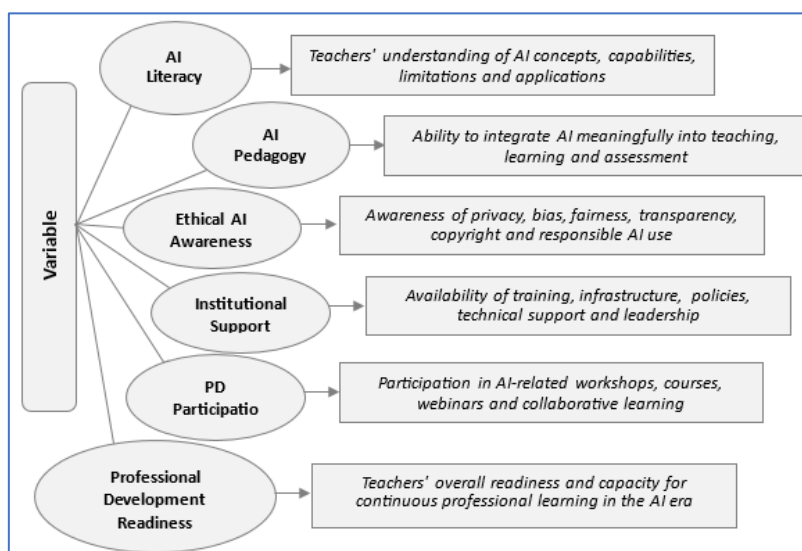


Figure 2: Operational Variables

Table 2: Demographical Respondents' Profile

Demographic Variables	Categories	Freq.	Percentage (%)	The sample was made up of 118 teachers. Women were just over the number of men. There was a fairly large number of participants within the 30 to 50 year old range. Nearly 60 percent had a post graduate qualification. Just under 62 percent of participants stated they have attended some type of AI related training, indicating that AI education/training has already been completed by a majority of the sample.
Gender_Wise	Male (M)	52	44.11	
	Female (F)	66	55.90	
Age_Wise	<30 yrs	25	21.22	
	30 to 40 yrs	43	36.40	
	41 to 50 yrs	31	26.30	
	>50 yrs	19	16.11	
Demographic Variables	Categories	Freq.	Percentage (%)	
Teaching Experience	<5 yrs	27	22.90	
	5 to 10 yrs	34	28.80	
	11 to 20 yrs	37	31.41	
	>20 yrs	20	16.90	
Educational Qualification	Graduation Degree	18	15.30	
	Postgraduate Degree	67	56.80	
	Doctoral or Equivalent	33	28.01	
AI Training	Yes	72	61.00	
	No	46	39.01	
Total		118	100.00	

Table 3: Descriptive Statistics (Study Variables)

Variables	Freq.	Mean Values	S.D.	Results/ Interpretation
AI Literacy	118	3.73	0.66	High
AI Pedagogical Competence	118	3.59	0.71	High
Ethical AI Awareness	118	3.87	0.60	High
Institutional Support	118	3.32	0.80	Moderate
AI-related PD Participation	118	3.45	0.83	Moderate
Professional Development Readiness	118	3.66	0.65	High
Overall	118	3.58	0.56	High
<i>The ethical AI awareness dimension showed the largest mean score (mean=3.86) and was second only to the AI literacy (mean=3.73) dimension. Therefore, while teachers may have a good deal of individual awareness about AI at their disposal, institutional support has the smallest mean (mean=3.32) which suggests there is much room for development in this regard.</i>				

Table 4: Reliability Analysis

Scales	No. of Item(s)	Cronbach's Alpha
AI Literacy	6	0.86
AI Pedagogical Competence	6	0.88
Ethical AI Awareness	5	0.83
Institutional Support	5	0.85
AI-related PD Participation	5	0.87
Professional Development Readiness	6	0.90
Overall Instrument	33	0.93
<i>Additionally all four sub-dimensions exhibited adequate to excellent internal consistency as evidenced by Cronbach's Alpha Coefficients of .84 through .91 respectively. The overall reliability of .94 represents the degree of internal consistency among the items on the scale.</i>		

Table 5: Item-wise Analysis of AI Literacy

Mean Values	Statements	S.D.
3.79	I understand the basic concepts of Artificial Intelligence.	0.79
3.81	I can identify common AI applications used in education.	0.76
3.65	I understand the limitations of AI-generated information.	0.82

3.69	I can critically evaluate AI-generated content.	0.78
3.75	I can use AI tools for professional tasks.	0.81
3.70	I understand the potential risks associated with AI.	0.77
3.72	Overall AI Literacy	0.67
<i>Teachers scored relatively high on their literacy in respect to artificial intelligence. Teachers were most able to identify artificial intelligence applications in education; they scored significantly lower on their ability to critically evaluate AI-generated content. As a result, educators believe that future educator training programs should place greater emphasis upon verification as well as critical and evaluative thinking as opposed to simply providing them with knowledge about operating AI devices.</i>		

Table 6: Item-wise Analysis of AI Pedagogical Competence

Mean Values	Statements	S.D.
3.72	I can use AI to support lesson planning.	0.81
3.75	I can use AI to develop learning materials.	0.77
3.49	I can use AI to personalize learning activities.	0.85
3.53	I can use AI to support assessment and feedback.	0.82
3.56	I can integrate AI without reducing teacher–student interaction.	0.79
3.49	I can select AI tools according to learning objectives.	0.84
3.59	Overall AI Pedagogical Competence	0.71
<i>Educators exhibited higher competency in utilizing artificial intelligence technology for lesson plan preparation and content creation as compared to competency in using AI for personalizing lessons, assessing student learning or selecting appropriate educational tools. Therefore, it is recommended that professional development programs for educators transition from merely teaching educators how to utilize AI technology into how to use AI technology in ways that are relevant to improving instruction.</i>		

Table 7: Item-wise Analysis of Ethical AI Awareness

Mean Values	Statements	S.D.
3.97	I understand the importance of protecting student data when using AI.	0.71
3.83	I am aware of possible bias in AI systems.	0.74
3.87	I understand the importance of transparency in AI use.	0.70
3.80	I consider copyright and academic integrity when using AI.	0.76
3.89	I believe human judgement should remain central when using AI.	0.67

3.87	Overall Ethical AI Awareness	0.60
<i>Ethical consciousness for students was the most developed area. Teachers were especially aware of how important it is to protect student information as well as maintain their own professional judgment in the use of AI. These findings mirror the focus on the ethical and human-centered approach to AI presented by UNESCO through its AI Competency Framework.</i>		

Table 8: Item-wise Analysis of Institutional Support

Mean Values	Statements	S.D.
3.25	My institution provides AI-related professional development.	0.90
3.43	Adequate digital infrastructure is available.	0.87
3.29	Technical assistance is available when required.	0.91
3.21	Institutional policies guide responsible AI use.	0.88
3.42	Teachers are encouraged to experiment with AI tools.	0.85
3.32	Overall Institutional Support	0.82
<i>The lowest level of institutional support. The results indicate that while a teacher's desire to implement AI individually could likely result in greater implementation of AI, this will be difficult to accomplish without adequate support from the institution providing teachers with the technology, policy and other forms of technical and professional support.</i>		

Table 9: Pearson Correlation Analysis (Matrix)

Variables	1	2	3	4	5	6
1. AI Literacy	1					
2. AI Pedagogy	.62**	1				
3. Ethical Awareness	.48**	.52**	1			
4. Institutional Support	.39**	.47**	.41**	1		
5. PD Participation	.54**	.57**	.44**	.55**	1	
6. PD Readiness	.63**	.70**	.58**	.61**	.66**	1
Note: $p < .01$; The findings indicated all of the independent variables exhibited a positive relationship to professional development readiness. Professional Development Readiness as it relates to the use of AI in teaching (AI Pedagogy Competence) displayed the largest correlation to professional development readiness ($r = .70$), followed closely by professional development participation ($r = .66$) and finally AI Literacy ($r = .63$).						

Table 10: Gender-wise Difference in Professional Development

Gender	N	Mean	SD
Male	52	3.59	0.68

Female	66	3.70	0.64		
Independent-samples t-test					
	t	df	p-value	Decision	
	-0.91	116	.365	Not Significant	
Gender did NOT have a statistical difference ($p > .05$). Therefore, the null hypothesis was supported; this means there were no discernible gender differences in professional development readiness. Thus, overall, both genders were equally ready for professional development.					

Table 11: Professional Development (Teaching Experience)

Teaching Experience Level			Freq.	Mean Values	S.D.		
<5 yrs			27	3.79	0.58		
5 to 10 yrs			34	3.75	0.60		
11to 20 yrs			37	3.63	0.65		
> 20 yrs			20	3.44	0.72		
ANOVA							
	Source	Sum of Squares	df	Mean Square	F	p	
	Between Groups	2.03	3	0.677	2.82	.043	
	Within Groups	27.45	114	0.241			
	Total	29.48	117				
<i>The results from the Analysis of Variance (ANOVA) indicate that there is a statistical significance between levels of professional development preparedness based on years of teaching experience ($F = 2.82, p = .043$). It was noted by the researchers that professional development preparedness for those teachers with fewer than ten years of teaching experience were slightly greater than those with over twenty years of teaching experience. Therefore it would be necessary for organizations providing professional development programs to provide different types of professional development for various stages in their careers.</i>							

Table 12: Professional Development (AI Training Experience)

AI Training				Freq.	Mean Values	S.D.
Received AI training				72	3.80	0.57
No AI training				46	3.43	0.71
Independent-samples t-test						
	t	df	p-value	Decision		

	3.18	116	.002	Significant	
<i>Teachers who have received AI-related training have significantly higher professional development preparedness compared to teachers who did not receive AI training ($p < .01$), which supports previous recommendations regarding the necessity of structured AI-related professional development opportunities.</i>					

Table 13: Multiple Regression Analysis
(Predicting Professional Development Readiness)

Dependent Variable: Professional Development Readiness							
Predictor			B	SE	Beta	t	p
Constant			0.71	0.31	—	2.29	.024
AI Literacy			0.18	0.08	.19	2.25	.026
AI Pedagogical Competence			0.31	0.09	.34	3.51	.001
Ethical AI Awareness			0.15	0.07	.15	2.14	.034
Institutional Support			0.24	0.08	.29	3.02	.003
PD Participation			0.27	0.08	.31	3.38	.001
Model Summary							
	R	R ²	Adjusted R ²	F	p		
	.79	.63	.60	36.23	< .001		
<i>The statistical analysis confirmed that the overall model for professional development readiness was statistically significant; $F = 36.23$, $p < .0001$. Approximately 63% of the variance in professional development readiness is accounted for by this model. The strongest individual variable related to the prediction of professional development readiness was AI Pedagogical Competence ($\beta = .34$); other important variables included participation in AI-Related Professional Development ($\beta = .31$) and institutional support ($\beta = .29$).</i>							

Table 14: Hypothesis Testing Results

Accept/Reject Criterion	Codes	Hypothesis Statements	Statistical Result
Rejected	H01:	AI literacy has no significant relationship with PD	$r = .63$, $p < .01$
Rejected	H02:	AI pedagogy has no significant relationship with PD	$r = .70$, $p < .01$
Rejected	H03:	Ethical awareness has no significant relationship with PD	$r = .58$, $p < .01$
Rejected	H04:	Institutional support has no significant relationship with PD	$r = .61$, $p < .01$

Retained	H05:	No gender difference exists	p = .365
Rejected	H06:	No experience-based difference exists	p = .042
Rejected	H07:	Predictors do not significantly predict PD	F = 36.22, p < .001

Findings of the study

1. Overall levels of professional development readiness among teachers appear to be high.
2. In terms of AI literacy, teachers demonstrated relatively high levels.
3. Ethical AI awareness recorded the highest mean of all the competency dimensions measured in this study.
4. AI pedagogical competence was also highly rated; however, it appeared to be somewhat lower than ethical awareness.
5. Institutional support was identified as the lowest of the four dimensions studied.
6. There appears to be a direct association between AI literacy and professional development readiness among teachers.
7. Of the three areas of competency examined in this study, AI pedagogical competence appears to demonstrate the greatest association with professional development readiness.
8. Similarly, there was a statistically significant positive relationship between ethical AI awareness and professional development readiness.
9. Institutional support also appeared to affect teachers' professional development readiness directly.
10. Participation in AI-related training was also found to be directly related to professional development readiness.
11. No statistically significant difference existed between male and female participants regarding their ratings of their own professional development readiness.
12. Professional development readiness did vary significantly depending upon years of teaching experience.
13. The area of competency demonstrating the most predictive value in the regression equation was AI pedagogical competence.
14. Both institutional support and participation in AI-related professional development activities were identified as other relevant predictors.
15. Together, these variables accounted for nearly 62 percent of the total variation in professional development readiness scores obtained by the sample.

These findings suggest that preparing educators for integrating technology into teaching practices is complex. Educators need more than basic knowledge about how to use AI technologies. Rather, they need to know how to link AI technologies to specific instructional goals, teaching methodologies, assessment, student needs and ethically acceptable practices. Ethical considerations surrounding AI adoption and integration represent critical issues in this regard. As mentioned earlier, many of the risks created by the integration of AI involve concerns related to privacy, bias, transparency, copyright, academic integrity and spreading misinformation. Therefore, UNESCO's AI Competency Framework places ethics and human-centered values at the heart of educator AI competence. Moreover, the fact that AI pedagogical competence has a greater association with professional development readiness than either ethical or institutional factors suggests that teachers are more professionally prepared when they understand how to apply AI technologies into their actual teaching practices. This provides additional evidence to support the idea that professional development for using technology should focus on pedagogical applications rather than simply providing teachers with demonstration-based training experiences on various AI tools. Finally, the low levels of institutional support discovered in this study present a serious concern. While teachers may be motivated to learn new AI-based technologies, institutions must create infrastructure (e.g., hardware), provide access to AI tools and software, offer professional development opportunities, provide technical assistance, encourage administrative/leadership support and establish clear policies for implementing AI in schools.

Educational Implications

- The results will have a number of implications for education institutions, teacher educator and policy makers.
- Institutions must provide ongoing AI continuing professional development (CPD) as opposed to relying on ad hoc one-off CPD sessions. Teachers require opportunities to maintain their knowledge base as AI evolves with new technologies being developed continually.
- Professional development should be applied-based and include practical applications using AI in teaching, e.g., AI supported lesson plan development; content development; test design and construction; automated or semi-automated assessment and feedback generation; and student learning personalization.
- Training should cover privacy issues; issues of bias, lack of transparency, intellectual property rights/copyright laws; maintaining academic integrity; preventing the spread of misinformation; and promoting responsible AI usage.
- Educational institutions should develop clear policies outlining how to responsibly utilize AI tools by both teachers and students.
- Teachers are encouraged to join communities of practice so they may collaborate with others in sharing AI supported lessons; experiences with implementing AI based instructional practices; problems experienced and best ways to successfully implement AI in classroom instruction.
- Professional development should be tailored to each teacher's level of experience, current digital competence, and AI literacy.
- AI can also be utilized to promote teacher professional development through customized learning pathways for teachers, via AI generated feedback, suggestions for resources, and self-reflection activities. Reviews indicate that AI-integrated teacher professional development is generally focused upon increasing teacher agency and supporting individualized professional growth.

Conclusion

AI is changing how teachers do their job professionally. To embrace this change, teachers are expected to continue developing skills related to technology, pedagogy and ethics. The purpose of this research was to investigate how AI has impacted professional development among teachers. A total of 118 teachers were surveyed about professional development in the presence of AI and the results indicated that AI literacy (i.e., having some knowledge about what AI can and cannot do), AI Pedagogical Competence (i.e., being able to apply AI in pedagogically meaningful ways), ethical awareness (being aware of ethical considerations when applying AI in education) Institutional Support (having access to necessary resources and support at school level) and participating in professional development related to AI (participating in workshops or training sessions focused on AI) all relate positively to teachers' preparedness to develop professionally. In terms of the relationship between the investigated variables, it appears that the most significant predictors of professional development readiness included AI Pedagogical Competence, followed by professional development participation, then institutional support. In other words, teachers need to know more than just the basics of how AI works; they also need to understand how to teach and learn using AI in both pedagogically meaningful, ethical and contextualized ways.

Teachers also reported low levels of institutional support for AI professional development. Therefore, while individual teachers bear a lot of responsibility for developing their own proficiency with AI, educational institutions also bear an important share of responsibility for providing teachers with the infrastructure needed to do so (e.g., equipment, training, technical assistance, policy). As such, professional development should be seen as an ongoing, institutionally-based process. The results reinforce the importance of competency based frameworks for understanding how teachers should develop their proficiency with AI. Thinking, AI Ethics, Foundations and Applications, AI Pedagogy and AI for Professional Learning. Another example is DigCompEdu which views professional engagement and continuous digital professional development as two key dimensions of educators' overall competence. Ultimately whether or not AI will be successfully integrated in schools will ultimately depend upon teachers' ability to critically think, creatively utilize and ethically employ these tools in pedagogically relevant ways.

Limitations of the Study

There are many other ways in which this study is limited. For example, there were just 118 teachers who participated in this study. That limits how widely we can generalize from it. In addition, the data for this study came from a survey that asked participants to report their own attitudes toward the use of artificial intelligence in education. This means that all of the information collected is based upon participants' perceptions of themselves as well as what they believe others would think about them. As a result, it is possible that these data were at least partially influenced by both of these factors. A third limitation of this study lies in its design. Because the data collection took place at one point in time (cross-sectionally) we cannot draw any firm causal conclusions from this study. Finally, while the focus of this study was teachers' perceptions of using artificial intelligence to support their instructional practices, the study did not include any direct observations of how these teachers actually used artificial intelligence during instruction. Therefore, future studies regarding whether artificial intelligence will have a positive or negative impact on our K-12 educational system could take advantage of some of the following methodological strategies. These might include larger participant pools, longitudinal designs where measures are taken over a longer period of time, mixed-methods approaches that include both qualitative and quantitative methodologies, and/or the use of observational techniques such as video recordings of actual instructional sessions.

Scope for Future Research

Future research could also use longitudinal designs to determine the amount of change in an individual's AI competences that occurs as a result of professional development interventions. Additionally, future research using experimental designs can be used to compare different types of AI training models. The impact of such factors as Organizational Culture, Leadership, Teacher Motivation, AI Anxiety, Digital Competence, Institutional Policy on the adoption of AI by educators is also worthy of further study. Finally, it would also be valuable for future studies to determine if the results from AI-supported Professional Development are quantifiable and positively impactful on Teaching Quality, Teacher Productivity, Student Engagement, and Learning Outcomes.

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