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AI Literacy and Professional Development Engagement as Predictors of Mathematics Teachers' Readiness for AI-Enhanced Instruction

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Abstract. This study examined how well AI literacy and professional development (PD) engagement can explain mathematics teachers' readiness for AI-enhanced instruction. Data were collected through a quantitative correlational design from all mathematics teachers at a private school in Metro Manila using three standardized tools: the AI Literacy Scale, a PD Engagement Survey, and the AI Readiness Questionnaire (RAIS). Results showed that teachers were skilled in using, interpreting, and evaluating AI tools; however, only AI-related training influenced their readiness, largely due to time-related structural constraints. A strong, statistically significant positive correlation was found between AI literacy and AI readiness dimensions using Spearman's rank correlation. Exploratory multiple regression analysis showed that AI literacy was the greatest contributor to the different domains of teachers' readiness most of the time ($\beta = 0.59$ to 0.66 , $p < 0.01$). PD engagement was shown to have a smaller, but significant impact ($\beta = 0.31$ to 0.36 , $p < 0.05$). These findings emphasize the importance of supporting in field-specific professional development to strengthen mathematics teachers' AI literacy to ready them to use AI in their teaching. The study suggests that embedding AI literacy in teacher education and offering flexible, relevant PD can help teachers adopt AI in mathematics classrooms in a responsible and effective way.

Keywords: AI Literacy; Professional Development; Teacher Readiness; AI-Enhanced Instruction; Mathematics Education

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1. Introduction

The rapid shift in educational technologies has transformed the traditional classroom, marking the beginning of a new era in education characterized by technology-mediated, interactive, and learner-centered environments (Mena-Guacas et al., 2025). Teaching today encompasses much more than merely books and chalkboards, with access to many more digital resources and learning platforms that allow students to become more involved in their learning. Digital teaching aids, such as interactive learning management systems and various AI teaching tools, promote both individual and collaborative learning.

Digital teaching aids motivate students to study and learn more outside of the classroom than ever before. Educators in previous decades did not have access to such resources. A recent study found that 81% of students felt that digital tools enhanced their academic performance, and 82% stated that educational technology improved their learning (McGraw-Hill Education Digital Study Trends Survey, 2016; Pangarkar, 2026). Historically, education has improved and advanced and the continued growth of AI within educational systems will similarly broaden and positively transform educational learning processes.

The learning experience in AI technology enhances classroom learning through automation, personalization, and outcome analysis. Teachers, especially in Mathematics, need adequate teaching and technical skills to optimize their use of these resources. Therefore, AI literacy becomes important. Teachers must comprehend, evaluate, and operationalize these resources in their teaching practice. Kohnke et al. (2025) argue that AI literacy is a fundamental necessity in classrooms that incorporate AI, not an optional addition.

Professional development that integrates ethics, teaching methodologies, and information technology that integrates ethics, teaching methodologies, and IT is more likely to promote the use of AI responsibly than technology-focused training alone. This study has some limitations regarding evidence on the value of training that incorporates a mindset shift, but there remains a gap in the research on the impact of AI on professional development across varying subject areas and environments. Lin, Zhang, and Xiong (2025) and Xu et al. (2024) state that the most pre-service teachers possess moderate AI literacy. However, limited research has been conducted to date on mathematics teachers, which constitutes a significant gap in the literature.

There is a need to assess how mathematics is taught in the Philippines. According to the 2022 Programme for International Student Assessment (PISA), the Philippines' average math score is 355, which is significantly lower than the average of 472 from the Organization for Economic Cooperation and Development (OECD). The majority of students from the Philippines earn the lowest score, 1B, indicating a widespread difficulty in grasping basic math concepts. Although the Philippines improved its score by 2 points in 2018, the increase remains statistically insignificant, as only 16% of students demonstrated a basic level of competence. Given the situation, traditional pedagogical methods and the educational resources employed in the instructional process need to be

improved. The application of AI in education is one option that needs to be embraced to assist students in learning mathematics. In addition to having strong knowledge of the learning content, Younis (2024) emphasizes that well-structured training on AI tools and their applications increases teachers' confidence and skills. Ng et al. (2023) indicate that teaching should be preceded by a higher level of skill in using digital and AI tools, and that professional development is needed to support that. The research that has been conducted is the only time mathematics teachers have been studied to determine their engagement in AI training and the extent to which that influences their ability to integrate AI tools such as ChatGPT into their everyday teaching.

Most recent studies have examined either AI literacy or professional development independently, and few have yet explored how the two together influence teacher readiness. For instance, Lin, Zhang, and Xiong (2025) studied what influences mathematics teachers' use of AI tools, such as their views on technology, beliefs, and AI literacy, but did not examine the link between AI literacy and professional development. These gaps highlight the importance of taking an integrated approach that considers both teachers' knowledge and their experiences when preparing them to implement AI in teaching.

1.1 Purpose Statement

This study examines how two key factors - AI literacy and professional development (PD) engagement - shape secondary mathematics teachers' readiness to use AI in their teaching. As AI becomes increasingly embedded in education, it is important to understand whether teachers have the necessary knowledge and training to adapt their teaching methods appropriately. By studying the connection between AI literacy, PD engagement, and instructional readiness, this research aims to generate insights that can help inform the design of teacher training programs as well as educational policies to support the effective and lasting use of AI in mathematics classrooms.

1.2 Research Questions

- a. What is the level of AI literacy among mathematics teachers?
- b. What is the extent of professional development engagement in AI-related training among mathematics teachers?
- c. What is the level of readiness for AI-enhanced instruction among mathematics teachers?
- d. Is there a significant relationship between AI literacy and readiness for AI-enhanced instruction?
- e. Do AI literacy and PD engagement significantly predict mathematics teachers' readiness for AI-enhanced instruction?

1.3 Research Hypotheses

This study examines whether mathematics teachers' AI literacy and professional development (PD) engagement significantly relate to and predict their readiness for AI-enhanced instruction. The following hypotheses were tested:

H_{04} : There is no significant relationship between AI literacy and readiness for AI-enhanced instruction.

H_{a4} :: There is a significant relationship between AI literacy and readiness for AI-enhanced instruction.

H_{05} :: AI literacy and PD engagement do not significantly predict mathematics teachers' readiness for AI-enhanced instruction.

H_{a5} :: AI literacy and PD engagement significantly predict mathematics teachers' readiness for AI-enhanced instruction.

2. Literature Review

AI technology is being embedded into educational systems to streamline teaching processes with tools that personalize learning, provide analytic support, and aid in summarizing administrative processes (Holmes et al., 2022). These educational aids advocate for positive teaching frameworks. Critical thinking and problem-solving are the primary skills developed during learning, and therefore, the use of AI teaching aids is crucial to supporting students in adapting to a more sophisticated learning environment.

Two interrelated factors influence educators' capacity to embrace AI-powered teaching: AI literacy and the extent of professional development (PD) attendance. Educators are expected to possess AI literacy, which includes an understanding of the algorithms and teaching tools associated with the technology, as well as the ability to engage with the pertinent ethical, privacy, and equity issues that the technology raises (Carolus et al., 2023). Simultaneously, PD attendance equips educators with the skills and confidence to effectively leverage cutting-edge instructional technologies (Howard et al., 2021; König et al., 2020).

All of these factors ultimately shape the extent to which educators are ready to incorporate AI into their teaching. Accordingly, this literature review identifies and analyses the existing scholarship on the intersections of AI in education, AI literacy, PD engagement, and teacher readiness to inform the research on the intersection of these variables and mathematics teachers' readiness for AI-powered teaching.

2.1 AI Readiness Model

The readiness for AI-enhanced teaching consists of three interconnected components which are technology self-efficacy, student engagement, and ethical dimension (see Figure 1).

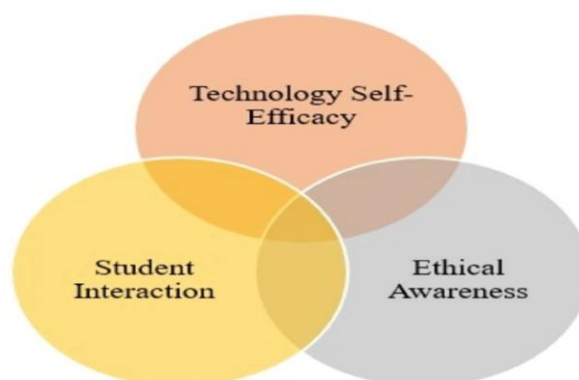


Figure 1: RAIS dimensions adopted from Ramazanoğlu and Akin (2024)

Instructors' belief that they will be able to utilize AI tools effectively is referred to as technology self-efficacy. According to Bandura's self-efficacy theory (1997), an individual's self-perception is an impetus for performance. This concept has been associated with the diffusion of technology in the classroom (Tondeur et al. 2017). The student interaction component focuses on the possible role of AI in enhancing collaboration, personalization, and learner's active participation.

Niess and Gillow-Wiles (2017) suggest that when teachers develop their technological pedagogical reasoning using a systems approach, they can better combine different technologies with teaching methods and content. This helps teachers use technology more effectively in their classrooms. In the context of AI-enhanced instruction, educators must also critically examine the implications of data privacy, algorithmic bias, and ethical use, as emphasized in more recent AI-in-education literature. These dimensions describe the major components of comprehensive AI readiness. Here, teachers are technologically confident, pedagogically responsive, and ethically grounded.

2.2 AI Literacy Model

One way to frame AI literacy is to adapt Bloom's taxonomy specifically for artificial intelligence, as illustrated in Figure 2.

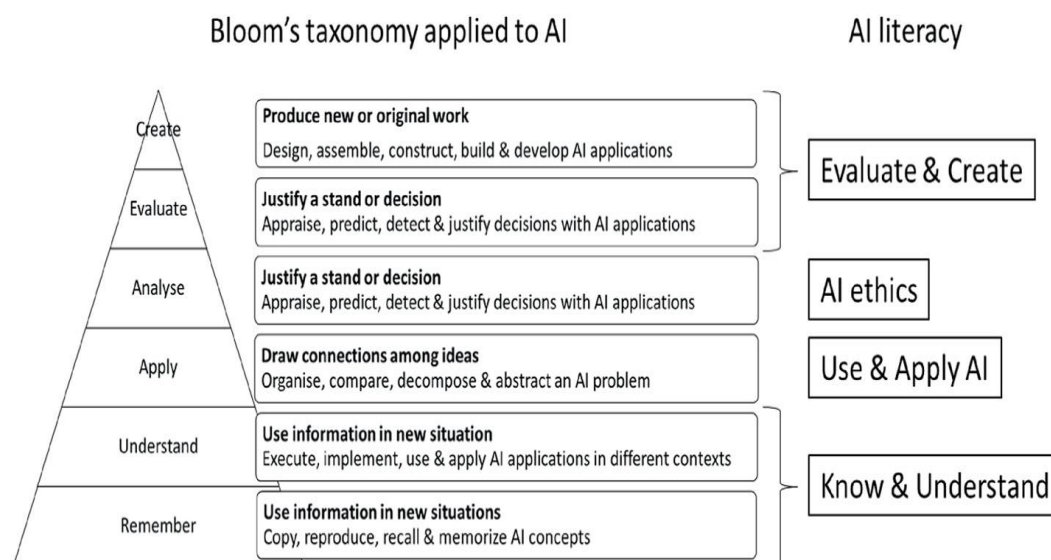


Figure 2: Bloom's Taxonomy and AI literacy adopted from Carolus et al. (2023)

At the foundational level, learners need to identify and describe the basic concepts of AI; in the next tier, they need to choose and use AI tools appropriately in everyday activities. Further, one needs to analyse and evaluate AI tools and systems to develop and improve original AI-based solutions (Long & Magerko, 2020). A persistent theme throughout this pyramid is the ethics of AI which calls for every learning experience to be anchored on the pillars of responsibility, fairness, and transparency (Zawacki-Richter et al., 2019). Therefore, the pyramid serves as more than merely a cognitive hierarchy. It also serves as a pathway for building the necessary reflective, ethical, and procedural skills for the responsible assimilation of AI. Educators with a significant level of AI literacy have the

opportunity to create learning experiences that integrate AI into teaching practice in a responsible way, evaluate its pedagogical purpose, and promote responsible innovation learning.

Combined, the two models combined provide a solid foundation for the current study. The AI literacy construct defines the blend of knowledge, skills, and ethical awareness needed for the appropriate and ethical use of AI, while the AI readiness framework outlines the resultant indicators of confidence, participation, and ethical concern in students that are visible in practice. Moreover, engagement in extended, collaboratively developed professional learning activities acts as a bridge that enhances both AI literacy and readiness to teach mathematics with AI. Research indicates that when teachers participate in such well-structured professional development, they are more likely to adapt to new technologies (Darling-Hammond et al., 2017; Trust et al., 2016). Thus, mathematics teachers' AI literacy, strengthened by professional development, determines their readiness to integrate AI into mathematics instruction.

2.3 Role of Artificial Intelligence in Education

The rapid rate at which AI technology is now being incorporated into education is noteworthy. According to the recent UNESCO (2023) report, AI technology can customize teaching and learning processes to support learners differently, relieving teachers of monotonous tasks, such as marking and other administrative work, and provide learning resources that can support diverse learners in inclusive classrooms. AI technology has been used in various educational practices, creating opportunities to improve teaching and learning, and to implement global educational reform. Consequently, there is a growing need to invest in research that focuses on the responsible and equitable use of AI technology in education

According to Harry (2023), AI can undertake administrative and teaching functions that would otherwise prevent teachers from focusing on learner engagement, thereby fostering meaningful interaction and thinking among learners. Furthermore, AI also provides learners with immediate feedback, adapts to individual students' learning needs, and recommends activities to consolidate learning, which is particularly important in such fields as mathematics that require precise, logical thinking (Harry, 2023). Additionally, AI contributes to more individualized learning experiences, streamlines classroom instruction, and increases educational productivity.

According to X. Lin and Tan (2025), AI advances education by developing personalized education pathways, promoting adaptive tutoring systems, and enhancing formative assessments via real-time learner assistance. Building on this, Kohnke and Moorhouse (2025) stress that generative AI is reshaping teachers' responsibilities in higher education, making it essential for them to understand and adapt to these technologies. Together, these studies show that integrating AI into education requires both technological adaptation and role redefinition among educators and learners.

The U.S. Department of Education (2023) aligns with those of Kohnke et al. by suggesting the need for the intelligent use of AI tools to assist and improve teachers' pedagogy and practice in a more humanistic way. Teaching with AI, as reported, augments education. However, the AI tools that assist in the teaching and learning process use a machine to perform learning tasks. The factors that affect the use of AI in teaching include the teacher's psychosocial readiness, the ethics of teaching, and the availability of resources to ensure equitable learning. The use of AI in teaching is an emerging practice intended to help teachers focus on essential learning activities.

2.4 Mathematics Education in the AI era

A new era of mathematics education has begun, as artificial intelligence starts to transform the processes of teaching, learning, and evaluation. Opesemowo and Adewuyi, (2024), describe these changes as a component of the Fourth Industrial Revolution, given the incorporation into the mathematics classroom of tools such as automated problem-solving, intelligent tutoring, and advanced data analytics. As noted in their extensive review, AI systems are able to assist students with the learning processes and offer timely feedback, both of which are demonstrated to improve the students' ability to complete complex problems. In this regard, Mukhibin et al. (2023) depict how, with the use of AI tools, numerous mathematical constraints can be alleviated, as learners can visualize technologies that depict concern and manipulative ideas.

Moreover, the tools enable teachers to customize the learning process for heterogeneous groups by using student data that is focused on individual learning pathways. However, the authors caution that AI should not be seen as a replacement for the teacher's instructional design and lesson delivery. Furthermore, Opesemowo and Ndlovu (2024) add another dimension by particularizing the duality. They demonstrate the potential benefits of enhancing educational quality and the risks of overdependence or misuse. The authors advocate for thorough teacher training and policy formulation to ensure the benefits of AI are realized while safeguarding academic integrity and fairness.

The challenges that mathematics educators face regarding the use of AI in pedagogy – including a lack of materials, limited opportunities for professional growth, and skepticism – are noted by Tashtoush et al (2024). Although their findings indicate strong initial interest in AI, the authors found that enthusiasm faded quickly once the system's constraints were realized. In the same context, Oved and Alt (2025) argue that AI will work best when used to augment rather than replace effective teaching. Overall, these studies highlight the urgent need for a change in mathematics teaching methods. To effect this change, educators need specific training, while schools must provide systemic support. The democratic use of AI in mathematics instruction is a complex undertaking that combines innovative technology with existing teaching methods and, most importantly, emphasizes the need for professional growth.

2.5 Teacher Readiness for AI-Enhanced Instruction

The integration of AI into everyday instructional practices is not a means of enhancing teacher practice; it is an act of instruction that transforms practice.

Citing Ayanwale et al. (2022), they argue that readiness encompasses concern, attitude, and intention, and that positive beliefs about one's capacity to use AI will lead to planning to use AI. They treat Wang et al. (2023) as an exception because of the positive attitude towards AI. In his layered model of readiness, Wang et al. (2023) refers to the three components: technical skills, adaptive pedagogy, and ethical reasoning. Research shows that when educators experience simultaneous growth in all three areas, their readiness increases. Granström and Oppi (2025) document the broad positive perception of AI at the practitioner level and assert that this drives readiness. They also cite the positive effects of consolidating professional development and organizational policy frameworks on teacher readiness.

Nerasaman and Abd Rahman (2025) report that experienced practitioners often appear more confident, although many of them fall into the trap of the confidence-knowledge gap when it comes to AI, suggesting that experience generates doubt, as well. The results presented showcase that having the ability to utilize AI in teaching from a personal perspective is one thing, but from an environmental perspective it is driven by how much the school invests in the support, training, and tools that are available to the teachers. In order to prepare schools to integrate AI into the classroom, it is important to develop and execute comprehensive strategies that address these issues and improve teacher readiness.

2.6 Conceptual Framework

The premise of this study is that teachers can only integrate artificial intelligence as a classroom resource if they understand AI technologies and have participated in relevant professional learning experiences. AI literacy has been conceptualized as a set of competencies enabling individuals to understand, interact with, evaluate, and use AI technologies responsibly, including consideration of ethical implications. The Meta AI literacy Scale, developed by Carolus et al. (2023), includes dimensions such as understanding AI concepts, using and applying AI, evaluating AI applications, and addressing the ethical aspects of AI.

Such competencies are essential for educators who aim to integrate AI tools into their pedagogy and curricula in a meaningful and responsible way. When educators engage in professional development (PD) activities, they gain the instructional strategies and pedagogical knowledge needed to integrate and use new instructional technologies (König et al., 2020; Howard et al., 2021). Research demonstrates that PD not only enhances teachers' confidence, skills, and willingness to use educational innovations, but also positively shapes their disposition towards innovation.

The framework suggest that the combined impact of AI literacy and PD engagement predicts teachers' readiness for AI-enhanced instruction. Readiness is conceptualized as a complex phenomenon that involves educators' technological self-efficacy, the ability to manage AI-facilitated dialogues with learners, and the ethical use of AI in education (Ramazanoğlu & Akin, 2024). Thus, the model provides a rationale for the proposed direct effect: the higher the level of AI literacy mathematics teachers has and the more they take part in

professional development activities, the more their ability to use AI as a teaching tool is expected to increase. See Figure 3.

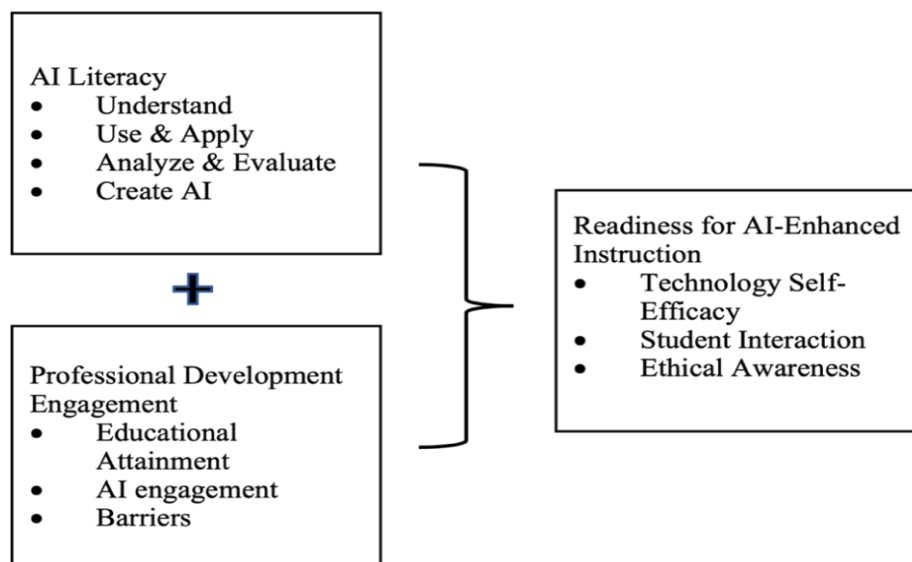


Figure 3: The influence of AI literacy and professional development engagement on mathematics teachers' readiness for AI-enhanced instruction

3. Methodology

The methodology used to determine AI literacy, professional development (PD) engagement, and mathematics teachers' readiness to teach with AI tools was a quantitative correlational design. For educational research, this type of design is most appropriate because, as Creswell (2014) describes, correlational studies analyse relationships among multiple independent and dependent variables without controlling, manipulating, or changing the environment. In this case, the researcher examined the impact of teachers' training and knowledge on their ability to use AI tools as teaching aids.

The participants of this study were comprised of all the mathematics teachers from one private school in Metro Manila, who were selected using a specific type of sampling method called purposive sampling. This sampling method is used in research when the researcher wants to have strong control over who is selected, in a way that meets the research objectives; in this case, the objective was to study mathematics teachers. Etikan (2016) states that this sampling method is acceptable when the researcher is focusing on a particular group anticipated to be the most knowledgeable or experienced regarding the phenomenon of interest. Math teachers were the participants because they are most involved in the teaching processes in which AI-enhanced education could be implemented, with a total of N=19 teaching staff included in the study. The participants' demographics showed diversity across teaching years, highest educational level, access to AI tools, and attendance at AI-centered professional development.

In order to ensure the validity and reliability of the data, three standardized tools were used. The AI literacy scale (Carolus et al. 2023) tested teachers' knowledge

of AI, including concepts, tools, applications in teaching, and ethics. The professional development engagement survey (self-report) captured the dimension of AI readiness regarding absence and the reasons for it, as well as the perceived value of AI-related professional development among teachers. The last tool used was the AI readiness survey (RAIS) (Ramazanoğlu & Akin, 2024), which measured teachers' attitudes and positive psychologies related to AI teaching, including confidence and willingness to employ AI in teaching. The data analysis process consisted of both descriptive and inferential analyses. For participant data, descriptive statistics (mean, standard deviation, frequency, and percentage) were applied to AI literacy levels, PD engagement, and readiness.

Regarding inferential data, the normality assumption was assessed using the Shapiro-Wilk test, and the data were found not to be normally distributed. Spearman's rank order correlation (ρ) was employed to understand the correlation of AI literacy, PD engagement, and AI readiness. An exploratory multiple regression analysis was also conducted to examine the extent to which AI literacy and PD engagement affect the various aspects of teacher readiness. Given the sample and study design, regression outcomes were considered inconclusive; final results were more definitive than the study and more confirmatory than the design. The research study focused solely on the intersection of AI literacy, professional development engagement and AI readiness. It did not include other contextual issues, such as institutional structure, leadership support, or student readiness, that could also obstruct teachers' readiness for AI-enhanced instruction.

4. Results and Discussions

In this part, the study's results are articulated and address the research questions regarding mathematics teachers' AI literacy, the AI-related professional development they participate in, and their readiness for AI-enhanced instruction. Descriptive statistics were used to assess levels of AI literacy, professional development, and AI-readiness. Relationships and predictive analyses explored how these factors are connected.

4.1 What is the level of AI literacy among mathematics teachers?

Teachers' AI literacy has been assessed and described across four dimensions: Use & Apply AI, Understand AI, Analyze & Evaluate AI, and Create AI. The data used for the scale interpretation ranged from 1.00-3.00 (low), 3.01-6.00 (moderate), and 6.01-10.00 (high). See Table 1.

Table 1: Levels of Teachers' AI Literacy

AI Literacy Dimension	M	SD	Level
Use & Apply AI	7.96	1.54	High
Understand AI	7.47	1.20	High
Analyze & Evaluate AI	7.37	1.67	High
Create AI	3.87	2.57	Moderate

M = Mean; SD = Standard Deviation; Scale levels: 1.00–3.00 = Low, 3.01–6.00 = Moderate, 6.01–10.00 = High.

The results indicate the teachers' significant competence in three aspects of AI: Use & Apply AI ($M = 7.96$, $SD = 1.54$); Understand AI ($M = 7.47$, $SD = 1.20$); and Analyze & Evaluate AI ($M = 7.37$, $SD = 1.67$). The high levels of competence in the three aspects of AI mean that the teachers have the confidence to encompass the different levels of AI systems, AI applications, and AI concepts. This finding aligns with previous studies (e.g., Ng et al. 2021, Long and Magerko 2020) where teachers are beginning to understand the potential of AI to assist in teaching, especially in the management of data within instructional design, student assessments, and classroom management.

Nevertheless, the Create AI score ($M = 3.87$, $SD = 2.57$) resulted in a moderate level. This suggests that, as a group, the teachers have just begun to develop a moderate range of technical skills for AI creation. The high spread suggests wide variation in results within the group. Low levels of higher-order technical skills within the study group mirror the low score in the AI dimension of Create AI. Numerous teachers expressed difficulty with AI application-related design or coding tasks, similar to Zawacki-Richter et al. (2019), whose findings reveal that while AI is readily embraced as a teaching partner, very few educators are able to develop the necessary algorithms. Clearly, the findings reflect a lack of teacher readiness, leaning more toward the critique and adaptation of AI tools that toward the synthesis and innovation of developing new tools.

For mathematics teachers, this gap is even more significant, as the ability to create or modify AI-based tools would foster personalized learning and improve problem-solving and data-analytical skills in instruction. Research shows educators understand AI tools but have only mediocre proficiency in creating solutions. In order to bridge this gap, professional development needs to be designed that integrates coding and model training with standard theory. Educators must learn to develop tailored applications that align with their teaching styles and students' needs to fully leverage AI in the classroom.

4.2 What is the extent of professional development engagement in AI-related training among mathematics teachers?

Findings are provided on the influence of AI-related professional development on the instructional readiness of mathematics teachers. Table 2 summarizes teachers' engagement, years of service, and obstacles in AI-related professional development. Figure 3 illustrates the teachers' assessment of the effect of this training on their readiness to teach AI in mathematics. These results consolidate the engagement in professional development and the teachers' readiness to instruct.

Table 2: Descriptive Statistics for Professional Development Engagement in AI-Related Training

Variable	Categories/Responses	f	%
Highest Educational Attainment	Bachelor's degree	18	94.7
	Master's degree	1	5.3
PD engagement related to AI in the past 12 months	Yes	13	68.42
	No	6	31.58
Years of Teaching Experience	1-5	11	57.90
	6-10	5	26.31
	11-15	2	10.53
	More than 15 years	1	5.26
Barriers to AI Professional Development Engagement	No barriers	4	21.05
	Lack of available training	4	21.05
	Lack of interest	2	10.53
	Lack of time	9	47.37

The results indicate that teachers' engagement with AI-related professional development (PD) sessions is moderate and inconsistent. This shows that the teaching workforce is transitioning in its approach to AI. Out of the 19 respondents, 13 (68.42%) teachers had participated in AI-related professional training, while 6 (31.58%) had not. This shows that, even though a high number of teachers are starting to participate in AI professional development, there is a systemic gap in the remaining proportion. The respondents' professional backgrounds explain this distribution of participation.

Most of the workforce consists of teachers in the early stages of their careers, with 57.90% of them having 1-5 years of teaching experience and 36.31% having 6-10 years. In addition, 94.7% of respondents hold a bachelor's degree, meaning that most teachers have had little opportunity to attend higher education institutions that use innovative teaching approaches, including AI. It is common to consider early-career teachers tech-savvy, but the findings suggest that tech-savvy does not always lead to higher participation in AI-related professional development.

Engagement in AI professional development suggests that most challenges stem from structural factors rather than a negative attitude. "Lack of time" was mentioned by the most respondents (47.37%), making it the most common barrier. On the other hand, 10.53% reported no barriers. It aligns more closely with the UNESCO (2023) report, which identifies a lack of supportive structures, particularly the distribution of time within teachers' work, as a major obstacle to substantial professional development. Given the sample's early-career proportions, the early-career promise is especially noteworthy.

Teachers in the first five years are often pulled in multiple directions by management, lesson planning, and administrative tasks. Thus, there is little room for any optional or externally calendar-locked PD sessions. Darling-Hammond et al. (2017) argue that for professional development to be effective and actually utilized, it must be job-embedded and, by extension, built into the workday, rather than being treated as an extra, external activity. Despite apparent willingness to engage in AI training, systemic PD models continue to exclude significant portions of the workforce.

The data in Table 2 indicate a somewhat concerning scenario for Mathematics educators and the AI-related PD opportunities. Sustained, though somewhat tenuous, PD participation is largely the result of individual teacher efforts. The current state of PD participation could create disparities in the levels of instructional support available in different classrooms, as some students will receive more AI-enhanced mathematics instruction than others.

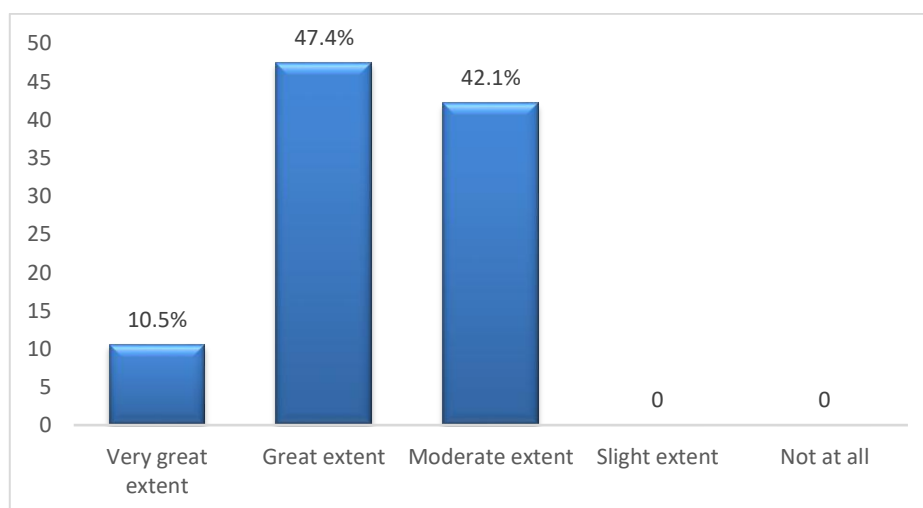


Figure 3: Teachers' responses on the extent of AI-related PD in enhanced readiness

A particularly distinct and more cohesive pattern emerges when the analysis shifts from participation to perceived impact. As shown in Figure 3, all participants (N=19) stated that AI-related professional development increased their readiness to use AI in mathematics to teach at least to a moderate level. More specifically, 42.1% of respondents chose a "moderate" level, 10.5% a "very great" level, and 47.4% a "great" level. Overall, no respondents selected "slight extent" or "not at all".

The above result applies best to models of technology adoption based on TPACK theory, which holds that perceived usefulness is the main driver of changes in teaching practices (Celik, 2022). 57.9% of survey participants reported a significant improvement, indicating alignment between current AI-related professional development initiatives and mathematics teachers' goals. The "lack of time" constraint mentioned before may also suggest disinterest or skepticism. If AI-related professional development initiatives were perceived as unimportant or irrelevant, expect ratings of readiness to decrease, rather than remain the same.

Rather, these findings suggest that a valuable resource is being critically underutilized. This situation highlights a key contrast: although its value and impact are broadly recognized, nearly one-third of teachers opted out of AI-related professional development. However, non-participating teachers do not appear to be avoiding the training due to a lack of interest but rather as a result of the constraints placed upon them by crowded work schedules. Schools are likely to be caught up in a two-tier environment in which an individual's AI readiness is determined not by their professional attributes but by their personal attributes. Overall, the results indicate that, among mathematics teachers, the degree to which they participate in AI-related professional development is more influenced by institutional capacity than by motivation.

Although participation levels are moderate, perceived effectiveness is high. This pattern suggests that the teachers are ready to integrate AI but face logistical problems. To eliminate the gap between engagement and impact, educational leaders need to go beyond voluntary PD models and embed AI training into protected, job-embedded professional learning time. This would improve participation and provide equitable readiness to all mathematics teachers in the age of AI in education.

4.3 What is the level of readiness for AI-enhanced instruction among mathematics teachers?

This part focuses on the level of readiness of mathematics teachers for instruction that incorporates artificial intelligence (AI). Teachers' AI readiness is summarized in Table 3. The results detail the readiness of mathematics teachers to use AI in their teaching practices. These results outline the gaps in readiness and indicate the support needed for mathematics teachers to teach effectively with AI.

Table 3: Levels of Mathematics Teachers' AI Readiness

Dimension	M	SD	Level
Technology Self-Efficacy	6.44	1.50	Moderate
Student Interaction	6.79	1.74	Moderate
Ethical Awareness	7.48	1.77	High

Scores were measured on a 10-point scale. Levels were classified as Low (1.00–3.99), Moderate (4.00–6.99), and High (7.00–10.00).

The analysis shows that mathematics teachers' overall AI readiness ranges from moderate to high across the three dimensions of the RAIS framework. The strongest dimension was Ethical Awareness, in which teachers scored an average of 7.48, indicating a high level of readiness. This suggests that teachers understand the ethical implications of AI to some degree, including fairness, privacy, accountability, and responsible use. Furthermore, teachers understand what is morally and professionally at stake, and thus what is required to ensure that AI is integrated responsibly and in a sustainable manner.

Teacher interaction with their students resulted in a mean score of 6.79, which is moderate-high, suggesting that teachers view themselves as being able to use AI

to assist and support student learning, foster student collaboration, and mentor students. This finding indicates that teachers have the potential to become AI proficient and to integrate AI in a manner that aligns with the interactive and engaging instructional practices.

Technology Self-Efficacy recorded the lowest mean ($M = 6.44$, $SD = 1.50$), placing it within the moderate readiness band. Thus, teachers displayed a moderate level of self-confidence in managing AI-enabled tools and pedagogical routines. Targeted professional learning that deepens technical skills and cultivates teaching self-efficacy could help address any remaining gaps, paving the way for more assured and effective AI integration in mathematics instruction. In summary, mathematics teachers are ethically prepared and moderately competent in AI-driven instruction, but sustained professional development is recommended to further boost their technical self-efficacy and classroom application skills.

4.4 Is there a significant relationship between AI literacy and readiness for AI-enhanced instruction?

This part explores the relationship between mathematics teachers' AI literacy and their readiness for AI-enhanced instruction. AI literacy reflects teachers' capacity to understand, apply, evaluate, and create AI tools, while the readiness dimensions capture confidence in technology use, strategies for engaging learners, and sensitivity to ethical aspects. Given the non-normal distribution of the data, Spearman's rho (ρ) was used to examine the strength and direction of the associations between AI literacy and each readiness dimension. The results of the correlation analysis are presented in Table 4 below.

Table 4: Spearman Correlations Between AI Literacy and AI Readiness

AI Literacy Dimension	Technology Self-Efficacy	Student Interaction	Ethical Awareness
Understand AI	.75	.72	.64
Use & Apply AI	.79	.70	.57
Analyze & Evaluate AI	.73	.76	.69
Create AI	.65	.66	.55

N = 19. Correlations are Spearman's rho (ρ). All correlations are statistically significant at the $p < .05$ level

Table 4 shows that the data exhibit strong, significant positive correlations across most dimensions of AI literacy and AI readiness. Specifically, the Understanding AI dimension was positively correlated with Technology Self-Efficacy ($\rho(17) = .75$, $p < .001$), Student Interaction ($\rho(17) = .72$, $p < .001$), and Ethical Awareness ($\rho(17) = .64$, $p = .004$), indicating that teachers with a stronger conceptual grasp of AI tend to feel more confident with technology, foster higher levels of student interaction, and demonstrate greater ethical awareness. The using and applying AI dimension showed similar positive associations with Technology Self-Efficacy ($\rho(17) = .79$, $p < .001$), Student Interaction ($\rho(17) = .70$, $p = .001$), and Ethical Awareness ($\rho(17) = .57$, $p = .011$). These results indicate that both conceptual

understanding and applied application of AI contribute to teachers' confidence, their ability to interact with students, and their ethical sensibilities regarding AI in instruction.

Within the analyze and evaluate AI dimension, strong positive correlations appear with ($\rho(17) = .73, p < .001$), Student Interaction ($\rho(17) = .76, p < .001$), and Ethical Awareness ($\rho(17) = .69, p = .001$). These results indicate that critical evaluation strengthens teachers' ability to use AI meaningfully and ethically. While the Create AI dimension coefficients are the lowest, it still shows significant positive correlations with Technology Self-Efficacy ($\rho(17) = .65, p < .003$), Student Interaction ($\rho(17) = .66, p = .002$), and Ethical Awareness ($\rho(17) = .55, p = .015$). This suggests that technical creation skills are linked to positive readiness outcomes, though this link is weaker and more varied than for foundational or analytical AI literacy.

Mathematics teachers with higher levels of AI literacy, especially in understanding, applying, and evaluating AI, are better equipped to incorporate AI within their teaching. Furthermore, they also create situations that engage students in active learning. This pattern corresponds with prior studies that have identified AI literacy as being important for embedding technology into teaching and learning (Long & Magerko, 2020; Ng et al., 2021). The observed relationship between AI literacy and self-technology efficacy is also consistent with the literature, which suggests that confidence in technology requires both understanding and practice.

According to research by Holmes et al. (2022), despite the positive correlation between creating AI and ethical awareness ($\rho = .55$), having technical skills alone does not guarantee ethical sensitivity. Moreover, their study highlights that ethical awareness in AI education must be taught intentionally and reflectively. This reinforces the need for professional development that integrates AI literacy with pedagogy and ethics, supporting educators to be more constructive and reflective in their AI practice.

4.5 Do AI literacy and PD engagement significantly predict mathematics teachers' readiness for AI-enhanced instruction?

An exploratory multiple regression analysis was used to examine the extent to which AI literacy and professional development (PD) relate to mathematics teachers' AI-enhanced instruction readiness. AI readiness was measured across three dimensions: Technology Self-efficacy, Student Interaction, and Ethical Awareness, as shown in Table 5.

Table 5: Exploratory predictive analysis in AI readiness dimensions from AI Literacy and PD Engagement

Readiness Dimension	Predictor	B	SE B	β	t	p
Technology Self-Efficacy	Constant	1.05	0.56	–	1.88	.078
	AI Literacy	0.71	0.20	.62	3.49	.003
	PD Engagement	0.38	0.19	.36	2.01	.049
Student Interaction	Constant	1.22	0.58	–	2.09	.052
	AI Literacy	0.65	0.20	.59	3.21	.005
	PD Engagement	0.35	0.17	.33	2.03	.049
Ethical Awareness	Constant	1.10	0.53	–	2.07	.054
	AI Literacy	0.72	0.18	.66	3.88	.001
	PD Engagement	0.32	0.15	.31	2.09	.047

All models significant, $R^2 = .52$ to $.58$. $p < .05$

Table 5 presents the analysis results and highlight the adjusted R-squared values for each readiness dimension. The models are statistically significant and account for 52%-58% of the variance in readiness outcomes. For Technology Self-Efficacy, the model explains 55% of the variance. Both AI literacy ($\beta = .62$, $p = .003$) and PD ($\beta = .36$, $p = .049$) are significant, with AI literacy having the greater effect. For Student Interaction, the model explains 52% of the variance. AI literacy ($\beta = .59$, $p = .005$) is the primary contributor, while PD ($\beta = .33$, $p = .049$) is a moderate and significant contributor. For Ethical Awareness, the model explains 58% of the variance. Both AI literacy ($\beta = .66$, $p = .001$) and PD ($\beta = .31$, $p = .047$) are significant. This creates the strongest model and suggests that ethical readiness depends on both technological and pedagogical training.

If both AI literacy and PD participation affect math teachers' readiness for AI-integrated teaching, then AI literacy is the most significant factor across all readiness dimensions. This aligns with the TPACK (Technological Pedagogical Content Knowledge) framework, which states that integrating technology requires a fusion of technological understanding and pedagogy (Mishra and Koehler, 2006). Teachers with high AI literacy showed instructional confidence. These teachers more purposefully and effectively address and understand the possibilities of the undesirable behaviors. This partially supports Niess's (2011) assertion that the AI context technological competence justifies the pedagogical change and extends it.

Still, AI literacy has the most significant influence, while the importance of professional development is undeniable. The impact of PD is relatively smaller (β range = .31 - .36), slightly significant, but PD engagement influences all models. This is consistent with the literature on the importance of PD in helping teachers integrate technology (Koehler et al., 2014; Tondeur et al., 2016). PD effects on student engagement align with Ertmer and Ottenbreit-Leftwich's (2010) position that PD promotes student-centered pedagogical practices. There is evidence here

that AI tools can be used most effectively by teachers with high AI literacy, and that pedagogical development involves integrating these tools.

Most findings stress the importance of dual pathways for mathematics teacher readiness in AI-informed instruction. Professional development is important, but it cannot compensate for the lack of baseline AI literacy. The findings indicate that AI literacy is the most significant factor in determining readiness. It equips educators to tackle the operational, instructional, and ethical aspects of AI. Professional development then clarifies and builds these competencies in a practical setting. Therefore, frameworks to enhance teacher readiness should center on deep, sustained, ongoing AI literacy and adaptive professional development to foster collaboration.

5. Conclusion

This study sought to provide insights into teachers' readiness for AI-enhanced mathematics instruction. Most mathematics teachers demonstrate the ability to understand, apply, and evaluate AI tools, but they tend to lack sufficient experience in creating AI systems. This demonstrates the urgency of technical training, especially at the design and development level, rather than at basic operational training. Regarding professional development, an almost equal number of teachers informed the researchers whether they had participated in AI training. This gap is predominantly caused by the design of the training program, particularly its time constraints, rather than by motivation or interest.

The study also reports that AI literacy is the best and most consistent predictor of teachers' readiness. Working knowledge and understanding of AI is significant in building teachers' confidence in the employment of AI in mathematics instruction. Even though professional development engagement is less consequential than AI literacy, it is important, especially in the areas of teacher facilitation of student interactions with AI and the ethical considerations of AI. These findings underline the need for basic AI literacy training and improvements in the design of training programs to minimize barriers to teachers' sustained professional development.

6. Conflict of Interest, Acknowledgements, etc.

This study has respected all relevant ethical considerations in educational research. Participants voluntarily provided informed consent after being properly debriefed about the objectives, procedures, and scope of the research. In accordance with the ethical principles of anonymity and confidentiality, responses were assigned coded identifiers, and the dataset was not labelled with any personal or organizational identifiers. The data set was also appropriately protected so that any data gathered were used exclusively for the research study, and access was restricted to comply with institutional and national research ethical standards regarding the study's participants. The researchers appreciate the private school administration for granting permission for the study and facilitating data collection. Thanks also go to the mathematics teachers for their participation and for sharing their time and insights. The authors declare that there are no conflicts of interest.

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