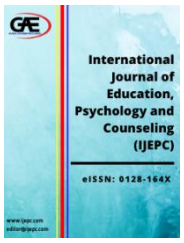
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AI READINESS AND PEDAGOGICAL CONFIDENCE AMONG STEM PRE-SERVICE TEACHERS AT IPGKTI: A RASCH MEASUREMENT ANALYSIS

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Abstract:

This study evaluates the readiness and pedagogical confidence of 66 STEM pre-service teachers at IPG Kampus Temenggong Ibrahim regarding the integration of Artificial Intelligence in primary classrooms. Using a quantitative survey analysed through the Rasch measurement model, the research identifies a significant "readiness gap". While trainees demonstrate high psychological motivation and positive attitudes toward AI adoption (aspirational readiness), their practical pedagogical confidence remains at moderate to low levels. Specifically, participants feel less prepared for complex tasks such as aligning AI with STEM curriculum requirements and utilising AI-generated data for student assessment. Systemic hurdles, including inconsistent internet connectivity and limited access to digital devices, further constrain their ability to implement AI effectively. The findings suggest that current training is often limited to theoretical knowledge rather than practical application. Therefore, teacher education programs must transition toward competency-based, hands-on training that emphasises AI-integrated lesson design, assessment literacy, and ethical data management. Strengthening institutional support and curriculum design is essential to ensure future educators can successfully navigate the digital transformation in Malaysian primary STEM education.

Keywords:

Pedagogical Confidence, Primary Stem Education, Readiness

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Introduction

The rapid advancement of artificial intelligence (AI) has transformed educational practices and created new opportunities for teaching and learning, particularly within science, technology, engineering, and mathematics (STEM) education. AI-supported applications have the potential to facilitate personalised learning, enhance student engagement, support critical thinking, and provide teachers with new approaches to instructional planning and assessment (Alshorman, 2024; Unal & Hobe, 2025). Within the Malaysian education context, these developments have increased the need to prepare future teachers with the knowledge, pedagogical skills, and confidence required to integrate AI meaningfully into classroom practice, particularly at the primary level (Er & Chongo, 2025).

Despite increasing interest in AI-supported education, pre-service teachers may not be equally prepared to translate positive perceptions of AI into effective pedagogical practice. Studies have shown that prospective teachers generally recognise the potential benefits of AI but continue to experience challenges related to limited AI knowledge, insufficient practical experience, resource constraints, ethical concerns, and uncertainty about how AI should be integrated into teaching and assessment (Alshorman, 2024; Ayanwale et al., 2024; Unal & Hobe, 2025). These challenges suggest that AI readiness extends beyond technological familiarity. It also involves pedagogical competence, psychological and motivational readiness, access to appropriate infrastructure, understanding of ethical responsibilities, and confidence in applying AI to specific instructional tasks.

This issue is particularly important in STEM education, where teachers are expected to combine technological tools with appropriate pedagogical strategies and disciplinary content. Although AI has received increasing scholarly and policy attention, empirical evidence on pre-service teachers' readiness to integrate AI into primary STEM classrooms remains limited, particularly in Malaysia (Avci et al., 2025; Er & Chongo, 2025; Saravanan & Kamrozzaman, 2025). Existing findings indicate that teachers and teacher trainees may demonstrate positive attitudes toward AI while still lacking the practical competencies required for AI-integrated lesson design, classroom implementation, assessment, interpretation of AI-generated information, and responsible use of AI technologies (Barna et al., 2025; Somabut et al., 2025; Unal & Hobe, 2025). This distinction between willingness to adopt AI and confidence in applying it pedagogically represents an important area for further investigation.

The need to understand teacher readiness has become increasingly relevant as Malaysia moves toward broader adoption of AI-related initiatives in education. The Malaysian government's intention to strengthen AI integration within the national education system, including initiatives associated with AI literacy and curriculum development, requires future teachers to develop

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competencies that extend beyond conceptual awareness to practical classroom application (Nerasaman & Rahman, 2025). However, limited hands-on training, uneven technological infrastructure, insufficient AI literacy, and inadequate professional preparation may restrict teachers' ability to implement AI effectively (AlAli & Wardat, 2024; Bian et al., 2024; Dayagbil et al., 2025). These constraints are especially relevant to pre-service teachers, who must acquire the necessary competencies during teacher education before entering professional practice.

Within this context, pedagogical confidence represents a critical component of AI integration. Pre-service teachers may be motivated to use AI but remain less confident in designing AI-integrated STEM lessons, aligning AI applications with curriculum objectives, facilitating students' use of AI, applying AI in formative and summative assessment, interpreting AI-generated data, and addressing ethical concerns. Such differences may create a gap between aspirational readiness and actual pedagogical capability. Understanding this gap is important because effective AI integration depends not only on willingness to adopt technology but also on teachers' capacity to apply it appropriately within specific curricular, instructional, assessment, and ethical contexts (Han, 2025; Iddrisu & Iddrisu, 2025; Somabut et al., 2025).

Accordingly, this study focuses on STEM trainee teachers at Institut Pendidikan Guru Kampus Temenggong Ibrahim (IPGKTI), Malaysia. The study examines their AI readiness and pedagogical confidence in integrating AI into primary STEM classrooms. Specifically, it investigates the overall levels of readiness and pedagogical confidence and identifies areas of relative strength and difficulty through Rasch item measures and item hierarchy. By examining both motivational readiness and practical pedagogical confidence, the study seeks to provide empirical evidence that may inform teacher-education curriculum development, competency-based AI training, institutional support, and professional preparation for future primary STEM teachers.

Research Objectives

This study aims to examine AI readiness and pedagogical confidence among STEM trainee teachers at Institut Pendidikan Guru Kampus Temenggong Ibrahim (IPGKTI) in integrating Artificial Intelligence into primary STEM classrooms. Specifically, the study seeks to:

1. determine the level of AI readiness among STEM trainee teachers at IPGKTI;
2. determine the level of pedagogical confidence among STEM trainee teachers in integrating AI into primary STEM teaching; and
3. identify the areas of strength and difficulty in AI readiness and pedagogical confidence based on Rasch item measures and item hierarchy.

Research Questions

The study addresses the following research questions:

1. What is the level of AI readiness among STEM trainee teachers at IPGKTI?
2. What is the level of pedagogical confidence among STEM trainee teachers in integrating AI into primary STEM classrooms?
3. Which aspects of AI readiness and pedagogical confidence represent the greatest st

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Methodology

This section describes the research design, participants and sampling procedures, research instrument, data-collection procedures, and analytical approach used to examine AI readiness and pedagogical confidence among STEM trainee teachers at Institut Pendidikan Guru Kampus Temenggong Ibrahim (IPGKTI).

Research Design

This study employed a quantitative cross-sectional survey design to examine the level of AI readiness and pedagogical confidence among STEM trainee teachers. The survey design was appropriate because it enabled the systematic collection of self-reported data concerning participants' knowledge, perceptions, motivational readiness, access to resources, and confidence in integrating AI into primary STEM teaching.

The study was descriptive rather than predictive. It did not seek to test causal relationships among Technology Acceptance Model (TAM), Technological Pedagogical Content Knowledge (TPACK), self-efficacy, or behavioural intention constructs. Instead, these theoretical perspectives were used to inform the conceptualisation of AI readiness and pedagogical confidence and to guide the development and organisation of questionnaire items related to technological, pedagogical, motivational, and contextual aspects of AI integration (Barna et al., 2025; Li, 2024; Sămărescu et al., 2024).

Participants and Sampling

The target population comprised trainee teachers specialising in primary STEM-related programmes at Institut Pendidikan Guru Kampus Temenggong Ibrahim (IPGKTI). A purposive sampling technique was used to select 66 trainee teachers from Science, Mathematics, and Design and Technology (Reka Bentuk dan Teknologi, RBT) specialisations.

Participants were selected based on their relevance to the research context. Eligible participants had completed at least one semester of pedagogical training and had prior exposure to educational technology concepts. These criteria were intended to ensure that respondents possessed sufficient pedagogical and technological background to provide informed responses regarding the integration of AI into primary STEM education.

The use of purposive sampling was appropriate because the study focused specifically on trainee teachers preparing to teach STEM-related subjects, who were therefore directly relevant to the investigation of AI readiness and pedagogical confidence. However, because the sample was drawn from a single teacher education institution and was not selected through probability sampling, the findings should be interpreted within the specific context of IPGKTI and should not be generalised to all Malaysian trainee teachers without caution.

Research Instrument

Data were collected using a self-administered questionnaire administered through Google Forms. The instrument consisted of 22 closed-ended items measured using a four-point Likert agreement scale. The questionnaire was designed to assess two main constructs: AI readiness

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and pedagogical confidence in integrating AI into primary STEM classrooms. The AI readiness construct comprised 14 items organised into five dimensions. The first dimension, Technological Readiness, was represented by one item assessing the trainee teachers' ability to independently explore and learn new AI-based applications for STEM teaching. The second dimension, AI Knowledge and Conceptual Understanding, comprised three items examining understanding of basic AI concepts, awareness of AI applications for primary STEM learning, and familiarity with AI tools commonly used in education.

The third dimension, Curriculum and Pedagogical Alignment, consisted of three items assessing the ability to integrate AI tools in accordance with STEM curriculum requirements, design learning activities that meaningfully incorporate AI, and align AI use with learning objectives and teaching strategies. The fourth dimension, Resource and Infrastructure, contained three items focusing on the availability of digital devices, internet connectivity, and access to appropriate AI tools or digital platforms for STEM teaching. The fifth dimension, Psychological and Motivational Readiness, comprised four items assessing interest in using AI, willingness to develop further AI knowledge, beliefs regarding the contribution of AI to STEM teaching and learning, and motivation to incorporate AI into future teaching practices. The distribution of these items is presented in Table 1.

Table 1. Distribution of Items Measuring AI Readiness for Integration in Primary STEM Classrooms

Number of items	Elements	Items
R1	Technological Readiness	I can independently explore and learn new AI-based applications for STEM teaching.
R2	AI Knowledge and	I understand the basic concepts of AI in education.
R3	Conceptual Understanding	I am aware of AI applications and methods to support primary STEM learning.
R4		I have a strong understanding of AI tools commonly used in education.
R5	Curriculum and Pedagogical	I can integrate AI tools aligned with STEM curriculum requirements.
R6	Alignment	I can design learning activities that meaningfully embed AI in STEM lessons.
R7		I can align AI use with learning objectives and teaching strategies.
R8	Resource and Infrastructure	My school provides sufficient digital devices to support AI integration.
R9		The internet connectivity in my school supports the use of AI tools in teaching.
R10		I have access to suitable AI tools or other digital platforms for STEM teaching.
R11	Psychological and Motivational	I am interested in using AI to support my STEM teaching practices.
R12		I am willing to learn more about AI for classroom usage.

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R13	I believe using AI can improve the quality of STEM teaching and learning.
R14	I feel motivated to adopt AI into my teaching approach.

The pedagogical confidence construct comprised eight items organised into five dimensions. AI-Integrated Lesson Design was assessed through one item examining confidence in designing STEM lessons incorporating AI tools. Classroom Implementation was represented by one item assessing perceived capability to integrate AI during classroom instruction. Facilitating Students' Learning with AI was assessed through one item examining confidence in assisting students to use AI tools to enhance engagement in learning.

The largest dimension, Assessing Learning with AI, consisted of four items addressing confidence in using AI to assess students' learning progress, provide feedback, interpret AI-generated data for instructional decision-making, and use AI effectively in both formative and summative assessment. Finally, Handling Challenges and Ethical Concerns was represented by one item assessing confidence in guiding students to use AI responsibly and ethically. The distribution of pedagogical confidence items is presented in Table 2.

Table 2. Distribution of Items Measuring Pedagogical Confidence in Integrating AI into Primary STEM Classrooms

Number of items	Elements	Items
P1	AI-Integrated Lesson Design	I am confident in designing STEM lessons that incorporate AI tools.
P2	Classroom Implementation	I feel capable of integrating AI during classroom instruction without disruption.
P3	Facilitating Students' Learning with AI	I can help students explore AI tools to enhance engagement in learning.
P4	Assessing Learning with AI	I am confident in using AI tools to assess students' learning progress.
P5		I feel capable of using AI to provide students with feedback.
P6		I can interpret AI-generated data to inform teaching decisions.
P7		I believe I can effectively use AI in both formative and summative assessments.
P8	Handling Challenges and Ethical Concerns	I am confident in my ability to guide students to use AI responsibly and ethically.

The instrument was developed to capture both individual and contextual aspects of AI integration. The readiness items addressed technological knowledge, conceptual understanding, pedagogical alignment, institutional resources, and motivational preparedness, whereas the pedagogical confidence items focused more specifically on the trainee teachers' perceived capability to apply AI within lesson planning, classroom implementation, student facilitation, assessment, and ethical practice.

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A four-point Likert agreement scale was used for all items to encourage participants to indicate a clear direction of agreement or disagreement and to avoid a neutral midpoint. Responses were subsequently analysed using the Rasch measurement model to examine item functioning, reliability, dimensionality, and the relative hierarchy of AI readiness and pedagogical confidence indicators.

Data Collection and Analysis

Following ethical approval from the Education Policy Planning and Research Division (EPRD), Ministry of Education Malaysia, the questionnaire was distributed to eligible STEM trainee teachers at IPGKTI through official communication channels. Participants were informed of the purpose of the study and provided informed consent before completing the questionnaire. Participation was voluntary, and anonymity and confidentiality were maintained throughout the data-collection process. All responses were collected using Google Forms and stored securely, with access restricted to the research team.

The data were analysed using the Rasch measurement model to examine the psychometric properties of the 22-item instrument and to evaluate the respondents' AI readiness and pedagogical confidence. The analysis included item polarity using Point-Measure Correlation (PTMEA CORR), item fit statistics based on Infit and Outfit Mean Square (MNSQ), person and item reliability, person and item separation, and Principal Component Analysis of Rasch residuals to examine unidimensionality. Item measures expressed in logits were also examined to establish the hierarchy of items and identify aspects that were relatively easier or more difficult for the trainee teachers to endorse.

A Wright Person-Item Map was used to examine the distribution of respondent measures relative to item difficulty and to determine the extent to which the instrument adequately targeted the readiness and pedagogical confidence levels of the respondents. Particular attention was given to items exhibiting misfit statistics, as these items may indicate ambiguity, multidimensionality, or differences between individual and institutional aspects of AI readiness. The Rasch analysis therefore provided evidence concerning the reliability, construct validity, item functioning, and relative strengths and difficulties associated with AI integration among STEM trainee teachers.

Results and Findings

Item Polarity and Fit Statistics

The Rasch measurement analysis showed that all 22 items had positive Point-Measure Correlation (PTMEA CORR) values, ranging from 0.51 to 0.74. Positive PTMEA CORR values indicate that the items functioned in the intended direction and contributed positively to the measurement of AI readiness and pedagogical confidence among STEM trainee teachers. These findings suggest that none of the items demonstrated negative item polarity. The Outfit Mean Square (MNSQ) values for the 22 items ranged from 0.47 to 2.14. Most items fell within the acceptable MNSQ range of 0.50 to 1.50 suggested for productive measurement (Bond & Fox, 2015). A total of 18 items met this criterion. However, four items, R8, R9, R10, and P7, showed Outfit MNSQ values outside the recommended range and therefore require further examination.

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Items R8, R9, and R10 represent the Resource and Infrastructure dimension and assess access to digital devices, internet connectivity, and suitable AI tools or digital platforms. Their misfit may indicate that responses to these items were influenced by contextual or institutional conditions rather than solely by the respondents' individual level of AI readiness. Item P7, which assesses confidence in using AI effectively for both formative and summative assessment, also showed misfit, suggesting that this item may involve a broader or more complex aspect of pedagogical confidence than the other items within the construct. These items were retained for interpretation in the present analysis but should be reviewed carefully in future refinement of the instrument.

Unidimensionality

Principal Component Analysis of Rasch residuals were conducted to examine the dimensionality of the instrument. The raw variance explained by the Rasch measures was 44.0%, exceeding the minimum criterion of 40% commonly used to indicate an acceptable level of explained variance. The unexplained variance in the first contrast was 11.2%, which was below the suggested threshold of 15% (Bond & Fox, 2015).

These findings provide evidence that the instrument demonstrated an acceptable level of unidimensionality. Nevertheless, the presence of four misfitting items, particularly the three items related to resources and infrastructure, indicates that the dimensional structure should be interpreted cautiously. These items may reflect contextual or institutional readiness in addition to individual AI readiness.

Reliability

The Rasch analysis indicated high reliability for both respondents and items. Person reliability was 0.92, indicating that the instrument consistently distinguished respondents according to their levels of AI readiness and pedagogical confidence. Item reliability was 0.87, indicating that the relative ordering of the items was sufficiently stable within the sample. Both reliability coefficients exceeded the commonly accepted value of 0.70, supporting the consistency of the measurement (Bond & Fox, 2015). Internal consistency was also satisfactory, with Cronbach's Alpha coefficients ranging from 0.80 to 0.90 across the measured constructs. Collectively, these results provide evidence of good measurement reliability, although the identified misfitting items require further consideration.

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Item STATISTICS: MISFIT ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	Item
9	203	65	.33	.31	1.91	2.90	2.14	2.99	A .51	.65	73.4	81.2	R9
8	188	65	1.53	.26	1.61	2.47	1.84	2.74	B .62	.63	65.6	73.1	R8
13	226	65	-1.92	.30	1.07	.46	1.55	1.31	C .53	.57	81.3	75.7	R13
10	202	65	.42	.31	1.32	1.23	1.53	1.63	D .63	.65	78.1	80.1	R10
4	202	65	.42	.31	1.14	.60	1.20	.75	E .59	.65	73.4	80.1	R4
6	195	65	1.02	.28	1.02	.15	1.17	.66	F .67	.64	73.4	77.4	R6
11	218	65	-1.17	.31	1.10	.56	.99	.08	G .64	.62	71.9	79.0	R11
20	198	65	.78	.29	.99	.02	1.10	.44	H .55	.64	84.4	79.3	P6
2	210	65	-.37	.32	1.07	.36	1.03	.19	I .65	.65	76.6	81.1	R2
16	202	65	.42	.31	1.00	.10	1.05	.25	J .67	.65	79.7	80.1	P2
1	202	65	.42	.31	.97	-.05	1.00	.11	K .56	.65	79.7	80.1	R1
5	199	65	.69	.29	.88	-.44	.94	-.11	k .62	.64	78.1	79.6	R5
17	208	65	-.16	.32	.86	-.49	.78	-.68	j .70	.65	81.3	81.1	P3
15	206	65	.04	.32	.84	-.57	.74	-.84	i .73	.65	81.3	81.3	P1
12	226	65	-1.92	.30	.80	-1.32	.64	-.91	h .64	.57	81.3	75.7	R12
7	203	65	.33	.31	.75	-.99	.57	-1.61	g .75	.65	79.7	81.2	R7
18	204	65	.24	.31	.74	-1.02	.72	-.94	f .69	.65	84.4	81.3	P4
19	204	65	.24	.31	.74	-1.04	.72	-.94	e .63	.65	90.6	81.3	P5
22	206	65	.04	.32	.71	-1.18	.74	-.83	d .71	.65	84.4	81.3	P8
14	217	65	-1.07	.31	.69	-1.58	.56	-1.55	c .70	.63	82.8	79.4	R14
3	210	65	-.37	.32	.67	-1.47	.53	-1.76	b .72	.65	85.9	81.1	R3
21	206	65	.04	.32	.60	-1.78	.47	-2.09	a .74	.65	87.5	81.3	P7
MEAN	206.1	65.0	.00	.31	.98	-.14	1.00	-.05			79.8	79.6	
P.SD	8.9	.0	.85	.01	.31	1.20	.43	1.33			5.6	2.2	

Figure 1: Item Statistics For All Items.

Item Hierarchy and Areas of Strength

The item hierarchy presented in Figure 1 and the Wright Person-Item Map in Figure 2 revealed clear differences in the relative ease with which respondents endorsed the 22 items. Items R12 and R13, both within the Psychological and Motivational Readiness dimension, were among the most highly endorsed items. R12 reflects willingness to learn more about AI for classroom use, while R13 represents the belief that AI can improve the quality of STEM teaching and learning.

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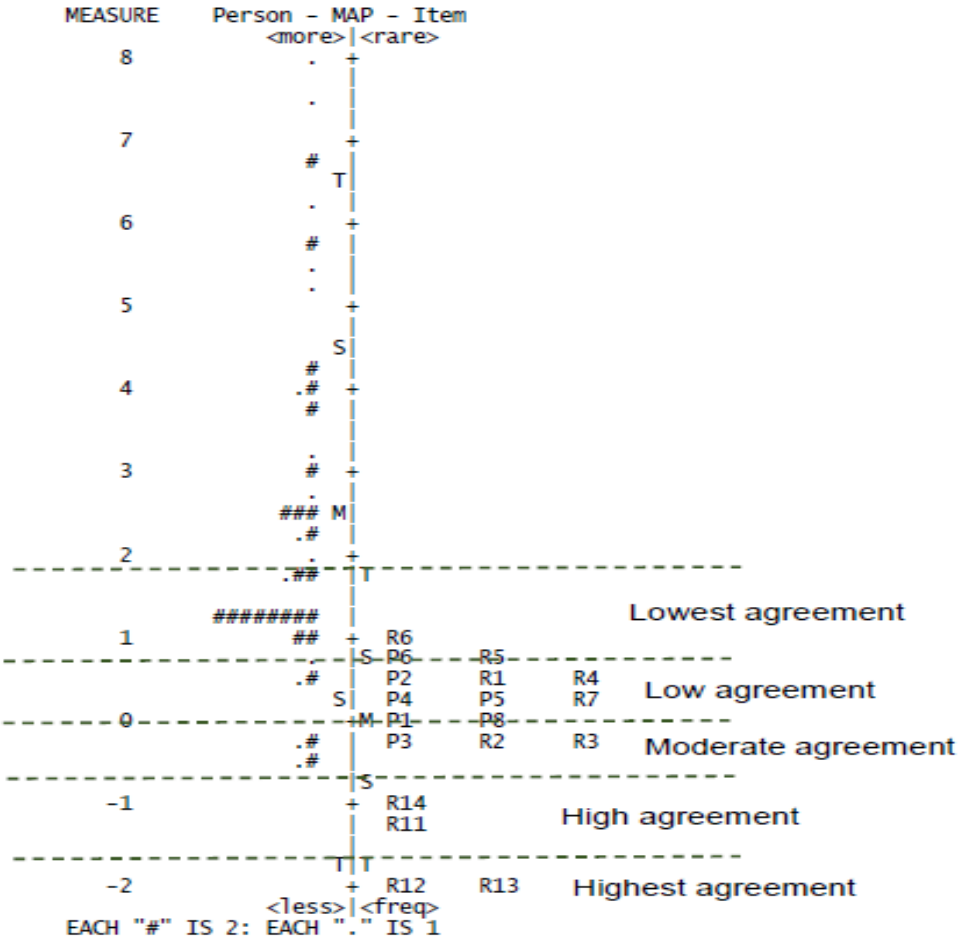


Figure 2: The Wright Map For All Items.

Items R11 and R14 also received relatively high endorsement. These items assess interest in using AI to support STEM teaching and motivation to incorporate AI into teaching practices. Taken together, the pattern suggests that IPGKTI STEM trainee teachers demonstrated comparatively strong psychological and motivational readiness for AI integration. The respondents appeared interested, willing to learn, and positively disposed toward the potential contribution of AI to STEM teaching and learning.

Areas of Moderate Readiness and Confidence

Items R2 and R3 were located within the moderate endorsement region. These items assess understanding of basic AI concepts and awareness of AI applications that can support primary STEM learning. The findings suggest that although respondents demonstrated a reasonable level of conceptual awareness, their AI knowledge was not as strongly endorsed as their motivational readiness.

Several pedagogical confidence items were also positioned within the moderate region. Item P1 assessed confidence in designing STEM lessons that incorporate AI tools, while item P3 examined confidence in helping students use AI tools to enhance engagement in learning. Item P8 assessed confidence in guiding students to use AI responsibly and ethically. The placement

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of these items indicates that trainee teachers possessed some confidence in applying AI pedagogically, but their confidence was less pronounced than their interest and motivation to adopt AI.

Areas of Greatest Difficulty

Items R5 and R6 were among the least highly endorsed readiness items. R5 assesses the ability to integrate AI tools in accordance with STEM curriculum requirements, whereas R6 measures the ability to design learning activities that meaningfully embed AI within STEM lessons. Their position within the lower endorsement region indicates that curriculum alignment and pedagogical integration represented relatively challenging aspects of AI readiness for the respondents.

Item P6 was also located within the lower endorsement region. This item assesses confidence in interpreting AI-generated data to inform teaching decisions. The finding suggests that respondents were less confident in using AI-generated information for assessment-related and data-informed instructional purposes.

Overall, the item hierarchy revealed a noticeable discrepancy between motivational readiness and applied pedagogical confidence. The STEM trainee teachers showed strong interest, willingness, and positive beliefs regarding AI, but comparatively lower readiness and confidence in curriculum alignment, AI-integrated lesson design, and interpreting AI-generated data for instructional decision-making. This pattern suggests that their readiness for AI integration was stronger at the motivational level than at the level of practical pedagogical application.

Discussion

The findings indicate a clear discrepancy between the psychological and motivational readiness of IPGKTI STEM trainee teachers and their confidence in applying AI in practical pedagogical contexts. Items R11 to R14, which represent interest, willingness to learn, perceived value, and motivation to adopt AI, were among the most highly endorsed items. This pattern suggests that the respondents generally held positive dispositions toward AI and were receptive to its potential role in STEM teaching. However, this positive orientation did not consistently translate into equally strong confidence in curriculum integration, lesson design, assessment, and the interpretation of AI-generated information.

This pattern may be understood as a form of aspirational readiness, in which trainee teachers demonstrate strong motivation and positive expectations regarding AI but remain less prepared for the practical demands of classroom implementation (Somabut et al., 2025). The findings therefore suggest that readiness for AI integration should not be interpreted solely in terms of willingness or positive attitudes. Effective integration also requires pedagogical knowledge, curriculum alignment, assessment competence, and the ability to apply AI tools within authentic instructional contexts. In the present study, these applied dimensions appeared less developed than motivational readiness.

A particularly important finding concerned curriculum and pedagogical alignment. Items R5 and R6 were among the least strongly endorsed items, indicating that respondents were less

confident in aligning AI tools with STEM curriculum requirements and in designing learning activities that meaningfully embed AI into instruction. This suggests that exposure to AI concepts or general educational technology may not be sufficient to prepare trainee teachers for curriculum-based AI integration. Instead, teacher education programmes may need to place greater emphasis on practical instructional design, including the selection of appropriate AI tools, alignment with learning objectives, lesson sequencing, and evaluation of the pedagogical value of AI-supported activities. This interpretation is consistent with studies that emphasise the importance of integrating technological knowledge with pedagogical and content knowledge in teacher preparation (Barna et al., 2025; Unal & Hobe, 2025).

The relatively low endorsement of item P6 further highlights a specific weakness in AI-related assessment literacy. Respondents demonstrated lower confidence in interpreting AI-generated data to inform teaching decisions. This finding is important because the educational value of AI extends beyond content generation or classroom engagement to include formative assessment, feedback, learner monitoring, and data-informed decision-making. Limited confidence in these areas may reduce teachers' willingness to use AI for assessment-related purposes, particularly when interpretation of automated outputs requires pedagogical judgement and data literacy (Han, 2025; Iddrisu & Iddrisu, 2025). Teacher preparation should therefore include structured opportunities to evaluate AI-generated feedback, interpret learning analytics, identify inaccuracies or bias, and determine when AI-supported assessment information is pedagogically appropriate.

The findings relating to resources and infrastructure require more cautious interpretation. Items R8, R9, and R10 showed misfit within the Rasch analysis. These items relate to access to digital devices, internet connectivity, and suitable AI platforms. Their misfit may indicate that they reflect contextual or institutional conditions rather than the individual readiness measured by many of the other items. In other words, access to infrastructure may influence the opportunity to use AI but may not operate in the same way as individual knowledge, motivation, or pedagogical confidence. This distinction is important because AI readiness may involve both individual and institutional dimensions. Previous studies have similarly identified infrastructure, technical support, and institutional policy as important contextual conditions affecting educational technology integration (Somabut et al., 2025; Zeng et al., 2025).

The moderate positioning of several pedagogical confidence items, including lesson design, facilitation of students' AI use, and ethical guidance, provides further evidence that the respondents were not entirely unprepared. Rather, their readiness appears to be uneven. They demonstrated stronger confidence in general engagement with AI and weaker confidence in more complex instructional tasks. This pattern suggests a developmental stage in which motivational acceptance has emerged more rapidly than applied pedagogical competence. Such a finding has practical implications for teacher education because training should move beyond introductory awareness of AI and provide repeated opportunities for authentic classroom application.

The findings therefore support a shift from predominantly conceptual exposure toward competency-based AI preparation in teacher education. Training should include hands-on AI-integrated lesson planning, classroom simulations, curriculum alignment activities, assessment design, interpretation of AI-generated data, and ethical decision-making. These experiences may help trainee teachers convert positive motivation into practical pedagogical competence.

Such an approach is consistent with calls for teacher education programmes to strengthen applied AI literacy and provide structured opportunities for future teachers to integrate emerging technologies into authentic teaching contexts (Barna et al., 2025; Lademann et al., 2026; Unal & Hobe, 2025).

Overall, the study suggests that AI readiness among IPGKTI STEM trainee teachers is multidimensional rather than uniform. Psychological and motivational readiness emerged as a relative strength, whereas curriculum integration and AI-supported assessment represented more challenging areas. The findings therefore highlight the importance of distinguishing between willingness to use AI and the competence required to implement it effectively in primary STEM classrooms.

Conclusion

This study examined AI readiness and pedagogical confidence among STEM trainee teachers at Institut Pendidikan Guru Kampus Temenggong Ibrahim. The findings indicate that respondents demonstrated comparatively strong psychological and motivational readiness toward AI integration, particularly in their interest, willingness to learn, and belief in the potential contribution of AI to STEM teaching and learning. In contrast, lower levels of readiness and confidence were observed in areas requiring more applied pedagogical competence, particularly curriculum alignment, AI-integrated learning design, and the interpretation of AI-generated data for instructional decision-making.

The Rasch analysis provided evidence of good measurement reliability and an acceptable level of unidimensionality. However, several items, particularly those related to resources and infrastructure and one assessment-related item, demonstrated misfit and therefore warrant further examination. These findings suggest that the instrument provides useful preliminary evidence for examining AI readiness and pedagogical confidence, while also indicating areas in which further refinement may be required.

The study highlights the need for teacher education programmes to move beyond general awareness and positive attitudes toward AI. Structured, competency-based preparation should provide trainee teachers with practical experience in AI-integrated lesson design, curriculum alignment, assessment literacy, interpretation of AI-generated information, and responsible and ethical AI use. Strengthening these areas may help bridge the gap between motivational readiness and practical pedagogical competence.

The findings provide context-specific evidence from IPGKTI and should therefore be interpreted within the limitations of a single-institution sample. Nevertheless, the study offers useful insights for the development of AI-related training within teacher education and identifies specific areas in which future STEM teachers may require additional preparation before integrating AI confidently and effectively into primary classrooms.

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