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Assessing the Relationship Between Anxiety and the Adoption of Artificial Intelligence Tools among Mathematics Preservice Teachers

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Abstract: Many revelations have been made about the revolution that artificial intelligence (AI) has brought to the education sector, including the opening of opportunities for personalised instruction, boosting the quality of content developed by teachers while preparing for lessons, and improving the quality of classroom evaluations. Despite the many benefits of AI adoption, there have been concerns and apprehensions about its use in the educational sector. A survey was conducted to investigate the relationship between AI anxiety and the adoption of artificial intelligence tools among mathematics preservice teachers who are university undergraduates studying mathematics education in Ekiti State, Nigeria. The study sample consisted of 129 mathematics preservice teachers selected through purposive sampling. The AI anxiety scale and AI adoption scale were used for data collection after being tested for reliability. The data collected through the scales were analysed using descriptive and inferential statistics. The findings of the study revealed that the mathematics preservice teachers had a high level of AI anxiety and adopted AI at a moderate level. The study further showed that there is a significant weak relationship between mathematics preservice teachers' AI-Anxiety and AI adoption. Also, there is no significant gender difference in mathematics preservice teachers' AI anxiety and AI adoption. Based on the findings of the study, it was recommended that teacher education programs include AI and digital literacy in the curriculum to prepare students for the seamless integration of AI. Additionally, targeted interventions should be implemented to reduce the anxiety exhibited by preservice teachers.

Keywords: Artificial intelligence, AI anxiety, AI adoption, preservice teachers, mathematics.

1. Introduction

Artificial intelligence (AI) is transforming classroom teaching activities, offering the potential to revolutionise the entire educational process, from lesson planning to delivery and student evaluation. AI encompasses the capabilities of machines to adapt to novel and evolving circumstances, solve problems, respond to queries, devise strategies, and carry out other intellectual behaviours typically associated with humans (Owan et al., 2023). Within the realm of computer science, AI refers to the discipline concerned with constructing computer systems capable of emulating intelligent behaviour and, ideally, advancing human-like skills (Nasution, 2023). AI tools are computer-based programs or applications designed to perform a variety of tasks, relying on vast amounts of data in a manner similar to human beings. The integration of AI technology has equipped educators with cutting-edge resources and capacities that have fundamentally transformed multiple aspects of teaching and learning (Haleem et al., 2022). AI is a crucial technological tool for optimising and personalising the educational process, encompassing activities such as automated lesson preparation and data-driven student assessment (Fitria, 2021). These AI tools possess the potential to completely revolutionise classroom instruction, offering tailor-made learning experiences, adaptive assessments, intelligent content creation, and data analytics (Ouyang & Jiao, 2021). This revolutionary impact of AI enables teachers to design more captivating, flexible, and effective

learning environments, fostering improved academic achievement and facilitating students in attaining their full potential (Saputra et al., 2023). The use of AI is not solely limited to teachers for various instructional activities but is also being employed by preservice teachers during their teaching practice to facilitate instructional activities (Samarescu et al., 2024).

Preservice teachers refer to undergraduate students who are enrolled in teacher education programs at universities or colleges of education, typically during their third or fourth year of study. During this time, they have the opportunity to gain practical teaching experience in secondary or primary schools under the supervision of an experienced teacher known as a cooperating teacher. The preservice teachers are assigned to an operational school unit, where they engage in observation and instruction within the context of teaching practice (Stavridis & Papadopoulou, 2022).

The primary objective of preservice teacher training is to equip undergraduates with the requisite practical skills and knowledge to apply what they have learned in the classroom. As part of their training, preservice teachers specialising in mathematics, who have undergone five to seven semesters of instruction on various teaching and learning theories in mathematics, are required to engage in a teaching practice exercise in schools for a duration of six to thirteen weeks, as commonly practised in Nigerian universities (Federal Republic of Nigeria, 2014). During this teaching practice period, preservice teachers are exposed to a range of instructional activities, including lesson preparation, which involves developing lesson plans and selecting appropriate teaching materials and strategies; lesson delivery, which entails conducting classroom instruction within a specified timeframe; and lesson evaluation, which includes assigning classwork, homework, tests, and examinations to students. Sebullen (2023) notes that these three fundamental tasks can pose challenges to preservice teachers. Furthermore, integrating technology into these practices presents additional challenges due to the preservice teachers' limited technological skills and inadequate infrastructure.

An examination of the adoption of AI tools by preservice mathematics teachers can be approached from a theoretical standpoint using the Technology Acceptance Model (TAM). TAM posits that the perceived ease of use and usefulness of technology are important factors influencing its adoption and utilisation (Davis, 1989). Preservice teachers' perceptions of the simplicity, usability, and alignment with their pedagogical ideas will likely play a role in their decision to use AI tools. Ayanwale et al. (2022) have identified perceived usefulness and ease of use as factors related to educators' readiness and intention to adopt AI for instructional purposes in schools. This suggests that when teachers perceive AI as useful and easy to use, they are more likely to adopt it for classroom instruction. On the other hand, considering potential anxiety related to AI, the technostress model can provide a relevant framework. The technostress model suggests that the demands and complexities of technological environments can lead to stress and anxiety among individuals (Brod, 1984). In the context of integrating AI technologies into teaching practices, the demands and complexities involved may contribute to heightened levels of AI-related anxiety among preservice mathematics teachers. As preservice mathematics teachers strive to incorporate AI tools into their teaching practices, their lack of technological literacy in this domain may exacerbate their experiences of AI-related stress and anxiety.

The transformative impact of AI technologies on the education sector cannot be underestimated. As the world embraces the fourth industrial revolution, interest in leveraging AI technologies in education continues to grow. The reasons why educators choose to use AI tools vary across different fields (Nja et al., 2023). Various factors have been identified as barriers to the adoption of AI tools, including lack of technical support (Nascimento & Meirelles, 2022), ethical concerns (Alanzi et al., 2023), technical complexity (Nguyen et al., 2022), and limited professional development opportunities on AI tools (Al-Mughairi & Bhaskar, 2024). According to Sánchez-Prieto et al. (2019), teachers refrain from using AI technologies due to perceived difficulties. Moreover, educators'

utilisation of AI technologies is influenced by their level of confidence in their computing abilities (Lestari & Indrasari, 2019). Hwang et al. (2020) found that self-efficacy, anxiety, perceived usefulness, and convenience of use accounted for seventy per cent of teachers' willingness to adopt AI. Al-Mughairi and Bhaskar (2024) also emphasised that concerns about the reliability and accuracy of AI are significant hindrances to its adoption. Thus, the relationship between anxiety and the adoption of AI is underscored. AI anxiety refers to the sensation of worry, apprehension, or dread experienced by individuals in relation to the utilisation of AI technologies. This psychological response arises from concerns regarding the potential impact of AI on various aspects of society, as well as the prospect of AI replacing human skills (Kaya et al., 2024). AI anxiety represents an excessive preoccupation with the challenges arising from advancements facilitated by AI technology, impacting both personal and societal spheres (Li & Huang, 2020). Deniz's (2022) investigation into the extent of AI anxiety among educators revealed a moderate level of AI anxiety among teachers. Additionally, Takil et al. (2022) explored the level of AI anxiety among university students and discovered a moderate level of AI anxiety within this population. Similarly, Aydug and Altinpulluk (2023) conducted a study on the level of AI anxiety among preservice teachers, revealing a moderate level of AI anxiety among this group. AI anxiety can be observed in preservice teachers, regardless of gender, when faced with challenges related to the implementation of AI tools (Ayanwale et al., 2024; Yıldız & Taşhan, 2023).

Gender differences in technology access, adoption, attitudes, and anxiety are prominent topics in the literature, often referred to as the gender-based digital divide (Reynolds, 2021). This divide reflects disparities between males and females in their use of technology, which are linked to cultural, social, and economic inequities in education (Goudeau et al., 2021). The gender-based digital divide can also reinforce and perpetuate other societal injustices (Deursen et al., 2021). Cai et al. (2017) suggest that females tend to exhibit more anxiety and apprehension about technology usage, including AI-based applications, compared to men. Factors such as socialisation, self-efficacy, and perceived usefulness of technology contribute to this gender-based AI anxiety disparity (Campos & Scherer, 2024; Wang et al., 2022). Furthermore, Campos and Scherer (2024) argue that gender differences in individuals' reactions to technology are linked, in part, to disparities in digital knowledge and skills. However, in the present study, gender differences in AI adoption and anxiety are specifically examined in the context of preservice teachers' willingness to use AI tools and their levels of anxiety or fear towards them. Aydug and Altinpulluk (2023) found a significant gender difference in AI anxiety levels among preservice teachers, with female preservice teachers exhibiting higher levels of anxiety compared to their male counterparts. In contrast, Takil et al. (2022) found no significant gender difference in AI anxiety levels among university students. However, they did note that female students tended to experience higher levels of AI anxiety. This suggests that gender could potentially influence individual AI anxiety and the adoption of artificial intelligence tools during teaching practice exercises (TPEs).

1.1 Statement of the problem

This study aims to explore the correlation between AI anxiety and the adoption of AI tools by mathematics preservice teachers in their instructional practices. Given the continuous advancement of AI implementation in the field of education, it becomes imperative to examine the concerns surrounding its adoption. Undergraduates have been utilising AI, specifically ChatGPT, for the generation of academic content (Dergaa et al., 2023). The accurate and comprehensible generation of mathematical symbols and equations by AI tools holds significant importance when such outputs are utilised by preservice teachers in lesson planning. Preservice teachers play a critical role in shaping the trajectory of technology-enhanced mathematics education; therefore, comprehending the factors that influence their willingness to employ these cutting-edge technologies as AI continues to evolve and proliferate within educational contexts is crucial. Existing research suggests that AI anxiety may negatively impact individuals' attitudes and acceptance of AI-based technologies

(Dwivedi et al., 2023; Tsai et al., 2020), which is characterised by discomfort, unease, and mistrust towards AI. However, the precise nature of the relationship between AI anxiety and the utilisation of AI tools by mathematics preservice teachers remains largely unknown. As such, this study seeks to investigate the association between AI anxiety and the adoption of AI tools among mathematics preservice teachers. The following research questions guide the study:

- What is the level of AI anxiety among mathematics preservice teachers?
- What is the level of AI adoption among mathematics preservice teachers?
- Is there a relationship between AI anxiety and the adoption of artificial intelligence tools among mathematics preservice teachers?
- Is there a significant gender difference in mathematics preservice teachers' AI anxiety and AI adoption?

2. Methodology

The survey design was adopted to carry out the study. This makes it possible to collect accurate and relevant data, decide on the sampling techniques, minimise bias, and maximise response rates—all of which enhance the validity and quality of the results (Groves et al., 2009). The design does not allow the manipulation of variables since it does not try to add to or remove from the existing facts (Osiesi et al., 2023). Therefore, the survey design is appropriate for gathering data pertinent to this study's purpose of understanding the impact of AI anxiety on the adoption of AI tools among mathematics preservice teachers.

The target population of this study consisted of all preservice mathematics teachers in public universities in Ekiti State, Nigeria. A total of 129 preservice teachers in their third or fourth year and participating in teaching practice exercises were purposively selected from the three public universities in Ekiti State, Nigeria. The use of purposive sampling was deemed appropriate as the participants needed to be undergraduate students studying mathematics education and actively involved in teaching practice exercises. Purposive sampling is a suitable technique for quantitative research when the aim is to identify participants with specific traits or who meet specific requirements relevant to the study's objectives (Campbell et al., 2020). Therefore, it was chosen for this study. The sample was selected from both federal and state-owned universities in Ekiti State, southwest Nigeria.

2.1 Instrumentation

A self-developed questionnaire titled 'Mathematics Preservice Teacher AI-Anxiety and AI-Adoption Questionnaire (MPTAAQ)' (see Appendix 1) was used for data collection. The questionnaire consists of three sections (tagged sections A, B, and C). Section A requests the preservice teachers' demographic information, including their Gender, Age, TP class assigned, and Teaching Practice Experience (the number of times preservice teachers would be participating in teaching practices). Section B consists of a 15-item scale adapted from (Wang & Wang, 2022) to measure mathematics preservice teachers' AI-Anxiety level on a 5-point Likert scale ranging from strongly agree to strongly disagree. This scale is tagged as the Mathematics Preservice Teacher AI-Anxiety Scale (MPTAxS). The scale measures preservice teachers' AI-Anxiety from four dimensions: technology reliability – concerns about accuracy, bias, transparency, and accountability (items 1–4); technological dependence – concern about being lazy (items 5–8); technological threat – apprehension of having been affected in some way (items 9–12); and ethical concerns – concern of using AI inappropriately (items 13–15). Section C consists of a 10-item self-designed scale to measure the level of adoption of AI among mathematics preservice teachers in two dimensions: perceived benefits and competence. This scale is tagged as the Mathematics Preservice Teacher AI-Adoption Scale (MPTAdS). The instrument for the study was validated for face and content validity. To ensure face and content validity, the questionnaire items were written in easy-to-understand English so that individuals who are not undergraduates would be able to comprehend them. All the questionnaire items were

methodically organised to meet the study's objectives. To determine the reliability of the instrument, it was presented to preservice teachers outside the study area online, and 27 mathematics preservice teachers responded to it. The data gathered from this survey was subjected to analysis using the Cronbach Alpha method, and the reliability index of 0.794 and 0.802 was found for MPTAxS and MPTAdS, respectively. Google Forms was used to host the instrument online. The Google Forms link (https://forms.gle/u1EY3Tud8DsQjWuR9) was shared with the respondents by the researcher and research assistants who are mathematics teachers in Ekiti state secondary schools.

2.2 Data analysis and ethical considerations

The responses from the AI anxiety scale and AI adoption scale were coded as follows: Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, and Strongly Disagree = 1. The AI anxiety level and AI adoption level were computed based on the responses to the 15 items and 10 items, respectively. The computation shows that the minimum and maximum values for the AI-anxiety scale are 29 and 69, respectively, while for the AI-adoption scale, the minimum and maximum values are 22 and 50, respectively. Four levels of AI anxiety (Low, Moderate, High, and Very High) were measured. Low is considered normal or no anxiety, Moderate is considered mild, High is considered serious, and Very High is considered severe anxiety (Julian, 2011). For the AI anxiety scale, the category size was computed as 10. The computed AI-Anxiety was then re-computed into the following scale: 29-38 as 1 (low), 39-48 as 2 (moderate), 49-58 as 3 (High), and 59-69 as 4 (Very High). For the AI adoption scale, three levels of AI adoption (Low, Moderate, and High) were measured, and the category size was computed as 9.33≈9. To determine the levels, the initially computed AI-adoption value was re-computed as follows: 22-30 as 1 (low), 31-40 as 2 (moderate), and 41-50 as 3 (High). To address the study's research questions, descriptive and inferential statistical analysis was carried out on the computed data. The IBM SPSS Statistics 29 was the statistical software used for the data analysis.

The consent of the participants was sought. The study's participants were informed that their participation was completely voluntary and that they could withdraw at any time. They were also assured that their personal data would be safeguarded and that the information gathered would only be used for research purposes.

3. Results Presentation

The analysis below was presented to respond to the research questions raised above, which begins by presenting the respondents' demographic information in Table 1 below, followed by the answers to the research questions.

Table 1: *The participating preservice teachers' demographic characteristics*

Characteristics	Level	N	%
Teaching Practice Experience	First	78	60.5
	Second	51	39.5
Gender	Male	53	41.1
	Female	76	58.9
Age	19 – 21years	56	43.4
	22 – 24years	57	44.2
	25 – 27years	14	10.9
	above 27years	2	1.6
Assigned TP Class	Basic 7	38	29.5
	Basic 8	27	20.9
	Basic 9	21	16.3
	SS 1	30	23.3
	SS 2	8	6.2
	SS 3	5	3.9
	Total	**129**	**100.0**

Table 1 shows the demographic characteristics of the participating preservice teachers. The table indicates that 60.5% of the participants had their Teaching Practice Exercise (TPE) for the first time, while 39.5% were on their second TPE. The participants who had TPE for the first time are in the third year of the undergraduate teacher education program, while those who had the second TPE are in their final year of the undergraduate teacher education program at the university. This suggests that most of the mathematics preservice teachers who participated in the study are in their third year and experiencing TPE for the first time in the university's undergraduate teacher education program. The table also shows that 41.1% of the participants are male, while 58.9% are female. This implies that most of the mathematics preservice teachers who participated in the study are female. In terms of age, 43.4% of the mathematics preservice teachers are aged 19-21 years, 44.2% are 22-24 years, 10.9% are 25-27 years, and 1.6% are above 27 years. By implication, a larger percentage of the participants are below 25 years of age. Regarding the class in which the mathematics preservice teachers are practising, 29.5% were assigned to JSS 1, 20.9% to JSS 2, 16.3% to JSS 3, 23.3% to SSS 1, 6.2% to SSS 2, and 3.9% to SSS 3. This indicates that most of the mathematics preservice teachers were assigned to junior secondary schools.

3.1 Research questions

RQ1: What is the level of AI anxiety among mathematics preservice teachers?

To determine the level of AI-Anxiety among the mathematics preservice teachers, their responses to MPTAxS were computed and analysed; the results are presented in Table 2.

Table 2: *Level of AI anxiety among mathematics preservice teachers*

Level of AI-Anxiety	N	%
Low	13	10.1
Moderate	38	29.5
High	57	44.2
Very High	21	16.3
Total	**129**	**100.0**

Table 2 shows the level of AI anxiety among mathematics preservice teachers. The level of AI-Anxiety was categorised into four: low, moderate, high, and very high. From the table, 10.1% of the mathematics preservice teachers had a low level of AI-Anxiety, 29.5% at a moderate level, 44.2% at a high level, and 16.3% at a very high level. This indicates that most mathematics preservice teachers had a high level of AI anxiety. Figure 1 further displays the distribution pattern of the mathematics preservice teachers' AI anxiety levels.
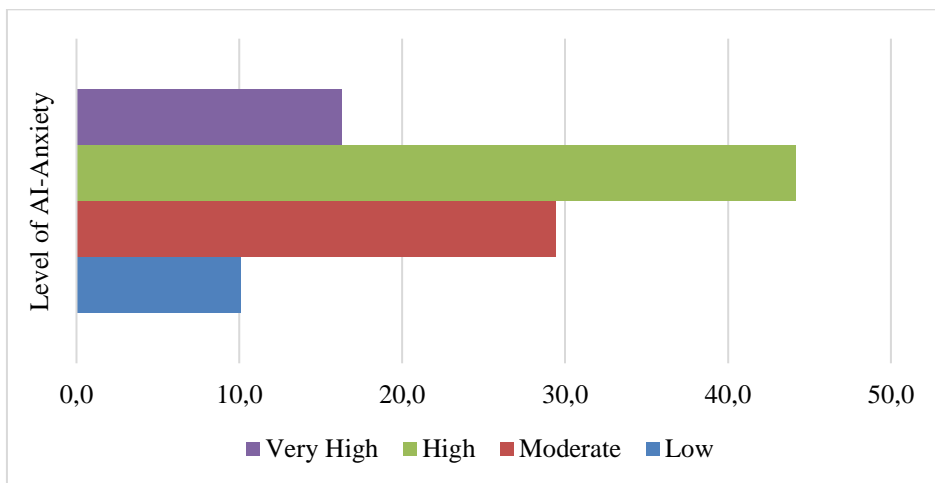

Figure 1: *Distribution Pattern of Mathematics Preservice Teachers' Level of AI-Anxiety*

RQ 2: What is the level of AI adoption among mathematics preservice teachers?

To determine the level of AI adoption among the mathematics preservice teachers, their responses to MPTAdS were computed and analysed, the results are presented in Table 3.

Table 3: Level of AI adoption among mathematics preservice teachers

Level of AI-Adoption	N	%
Low	22	17.1
Moderate	73	56.6
High	34	26.4
Total	**129**	**100.0**

Table 3 reveals the level of AI adoption as indicated by the mathematics preservice teachers. There were three levels of AI adoption depicted: Low, Moderate, and High. The table shows that 17.1% of the mathematics preservice teachers had a low level of AI adoption, 56.6% at a moderate level, and 26.5% at a high level. This implies that a large percentage of mathematics preservice teachers adopt AI during teaching practice exercises at a moderate level. As an additional visual, Figure 2 shows the distribution pattern of AI adoption levels among mathematics preservice teachers.
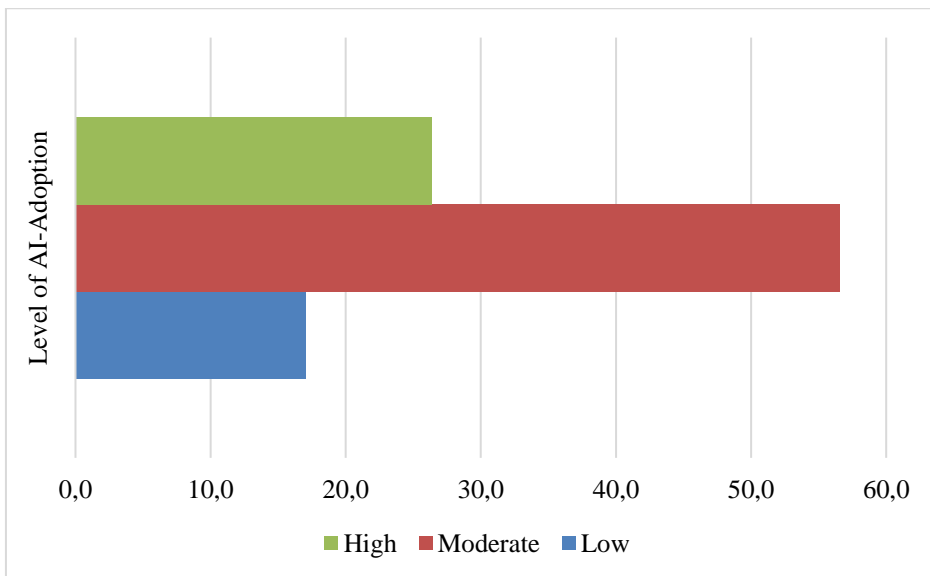

Figure 2: Distribution pattern of mathematics preservice teachers' level of AI adoption

RQ 3: Is there a relationship between AI-Anxiety and the adoption of artificial intelligence tools among mathematics preservice teachers?

Table 4: Correlation of mathematics preservice teachers' AI anxiety and adoption

Variable	Mean	S.D.	N	df	r	p
AI-Anxiety	49.95	8.18	129	127	.26	.003
AI-Adoption	36.95	5.84				

Significant at P<0.05

Table 4 presents the relationship between mathematics preservice teachers' AI anxiety and AI adoption. The table shows that there is a positive correlation between mathematics preservice teachers' AI anxiety and AI adoption. The relationship between AI anxiety and AI adoption is statistically significant ($r(127) = 0.26$, $p < 0.05$). Therefore, there is a significant weak relationship between mathematics preservice teachers' AI anxiety and AI adoption. The correlation coefficient suggests that although there is a statistically significant positive association between AI anxiety and

AI adoption, the strength of this relationship is quite weak. This indicates that AI anxiety is one of the factors that may influence preservice teachers' willingness to adopt AI-based tools, but other variables are likely to also play a role in their adoption decisions.

RQ 4: Is there a significant gender difference in mathematics preservice teachers' AI anxiety and AI adoption?

Table 5: Gender difference in mathematics preservice teachers' AI anxiety and ai-adoption

Variable	Level	Gender		Total (%)	df	χ^2	p
		Male(%)	Female(%)				
AI-Anxiety	Low	5 (9.4)	8 (10.5)	13 (10.1)	3	.570	.903
	Moderate	16 (30.2)	22 (28.9)	38 (29.5)			
	High	22 (41.5)	35 (46.1)	57 (44.2)			
	Very High	10 (18.9)	11 (14.5)	21 (16.3)			
AI-Adoption	Low	8 (15.1)	14 (18.4)	22 (17.1)	2	4.180	.124
	Moderate	26 (49.1)	47 (61.8)	73 (56.6)			
	High	19(35.8)	15 (19.7)	34 (26.4)			
Total		**53 (41.1)**	**76 (58.9)**	**129 (100)**			

Significant at P<0.05

Table 5 presents gender differences in the mathematics preservice teachers' AI-Anxiety and AI-Adoption. For AI-Anxiety, a larger percentage of both male (41.5%) and female (46.1%) mathematics preservice teachers have a high level. The table also shows that there is no significant gender difference (χ^2 (3,129) = .57, p = .903) in the mathematics preservice teachers' level of AI-Anxiety. This indicates that AI-Anxiety is not specific to a particular gender; it affects both male and female mathematics preservice teachers. Table 5 also shows that a larger percentage of male (49.1%) and female (61.8%) mathematics preservice teachers have moderate levels of AI-Adoption, although a higher percentage of males (35.8%) had a high level compared to females (19.7%). The table also indicates that there is no significant gender difference (χ^2 (2,129) = 4.108, p = .124) in the mathematics preservice teachers' level of AI adoption. Hence, there is no significant gender difference in mathematics preservice teachers' AI anxiety and AI adoption. This suggests that among preservice maths teachers, gender is not an influential variable in AI anxiety and AI adoption.

4. Discussion of Findings

The study investigated the relationship between AI anxiety and the adoption of artificial intelligence tools among mathematics preservice teachers. The study examines the level of AI anxiety among mathematics preservice teachers and found that most of the mathematics preservice teachers had a high level of AI anxiety. This is in line with the findings of previous studies that have shown that feeling uneasy and concerned over artificial intelligence technology is a widespread phenomenon, especially among those who have had minimal exposure and experience with AI (Ayanwale et al., 2024; Yıldız & Taşhan, 2023). This study's finding emphasises the existence of AI anxiety among mathematics preservice teachers. Regarding the existence of AI anxiety among preservice teachers, this study aligns with Aydug and Altinpulluk (2023), who found that preservice teachers exhibit some forms of AI anxiety. The finding of this study is also supported by the findings of Takil et al. (2022) and Deniz (2022), who reveal that university students have AI-anxiety and AI-anxiety exists among teachers respectively. However, the finding of the study on the level of AI anxiety is in disagreement with Aydug and Altinpulluk (2023), Takil et al. (2022), and Deniz (2022), who all found AI anxiety to be at a moderate level among preservice teachers, university students, and teachers respectively. The variation found between this study and the previously conducted studies could be the categories of AI anxiety level; in this study, four (low to very high) levels were involved, while

in other studies, three (low to high) levels were involved. This study gives a clearer picture of how severe AI anxiety is among preservice teachers.

This study also shows that a large proportion of mathematics preservice teachers adopt AI during teaching practice exercises at a moderate level. This finding aligns with (Rodway & Schepman, 2023), who found that undergraduates adopt AI for various academic reasons at a moderate level. This study's finding, however, contradicts the finding of Sánchez-Prieto et al. (2019), who stated that teachers do not employ AI technologies because they find them too difficult to use. Many reasons may have accounted for the level of adoption among the preservice teachers. According to Ayanwale et al. (2024), factors like attitudes, anxiety, readiness, goals, and confidence towards AI will have practical implications for influencing preservice teachers' adoption of AI and interest in learning AI. Similarly, Hwang et al. (2020) identified contributing factors affecting AI adoption in schools, such as self-efficacy, anxiety, usefulness, and convenience of use. The adoption of AI by mathematics preservice teachers could assist them in planning for classroom instruction, particularly in preparing their lesson notes and finding appropriate instructional materials.

The study further shows that there is a significant weak relationship between mathematics preservice teachers' AI-Anxiety and AI-Adoption. This study aligns with some studies (Ayanwale et al., 2024; Yıldız & Taşhan, 2023; Zhang et al., 2023) that stressed AI-Adoption as being influenced by the level of AI-Anxiety. This indicates that while AI-Anxiety may be a barrier to the full integration of AI in mathematics instruction by preservice teachers, other factors, such as perceived usefulness, ease of use, and institutional support, may play a more significant role in shaping preservice teachers' adoption decisions (Ayanwale et al., 2024; Yıldız & Taşhan, 2023; Zhang et al., 2023). Considering the unusual relationship between AI anxiety and the adoption of AI tools, it is important to note that individuals experiencing high levels of AI anxiety may feel a sense of discomfort and tension. To resolve this cognitive dissonance, they may be motivated to engage more with AI tools as a way to confront and potentially reduce their anxiety. Additionally, the moderate level of AI adoption reported among the preservice teachers suggests a willingness to engage with AI despite their high levels of anxiety. This gradual exposure and experience with AI tools may help to desensitise the preservice teachers gradually, leading to a reduction in their AI anxiety levels over time. Furthermore, preservice teachers may recognise the growing importance and practical necessity of incorporating AI tools into their teaching practices despite their personal anxieties. The desire to meet professional expectations and overcome practical constraints may compel them to adopt AI tools, even if they experience high levels of anxiety about doing so. All these factors, combined with the preservice teachers' proactive coping strategies and the potential for increased familiarity to overcome resistance, may have contributed to the positive relationship between AI anxiety and the adoption of AI tools among mathematics preservice teachers. This is an indication that preservice teachers' usage of AI tools is not solely influenced by AI anxiety. Few studies have looked at the connection between artificial intelligence adoption and anxiety.

Also, the study shows that there is no significant gender difference in mathematics preservice teachers' AI-Anxiety and AI-Adoption. This contrasts with Cai et al. (2017), where females often feel more nervous and concerned about using technology—including AI-based applications—than males. Also, it contradicts Aydug and Altinpulluk (2023) who recognised a statistically significant difference in the prevalence of AI-Anxiety between male and female preservice teachers, with females experiencing it more. However, the finding of this study is in line with Takil et al. (2022), who found no significant gender difference in the level of AI-Anxiety among university students. The lack of gender-based differences in this study may suggest that AI-related attitudes and behaviours are more influenced by factors beyond gender, such as personal experiences, educational background, and institutional policies (Campos & Scherer, 2024; Wang et al., 2022). This finding demonstrates that there is no gender gap between male and female AI-Anxiety and AI adoption;

therefore, the same approach or treatment would better be directed towards resolving the worries and concerns about the adoption of AI.

5. Conclusion and Recommendations

The impact of AI anxiety on the adoption of artificial intelligence tools among preservice mathematics teachers was examined through data gathered from a survey of preservice teachers. The research findings lead to the conclusion that preservice teachers' high level of AI anxiety influences their adoption of AI. The high levels of AI anxiety that have been noted indicate that teacher preparation programs should focus more on removing the emotional barriers that prevent preservice teachers from embracing AI techniques and technologies. Additionally, preservice teachers are not taking full advantage of the AI tools, as they only moderately adopt them for their teaching practice exercises. Furthermore, the relationship between AI anxiety and AI tool adoption is weak. This suggests that factors other than anxiety, such as competence, confidence, institutional support, and demographic characteristics, could potentially influence the degree of AI integration. It is also concluded that there is no gender difference in the level of AI adoption or anxiety in mathematics instruction, indicating that these issues may affect all preservice teachers equally. This emphasises the need for comprehensive, inclusive interventions to prepare all aspiring math teachers to make use of AI in the classroom.

Based on the findings of the study, it is recommended that teacher education programs include AI and digital literacy in the curriculum to prepare preservice teachers for the seamless integration of AI. Additionally, targeted interventions should be implemented to reduce the anxiety exhibited by preservice teachers when using AI and to encourage its proper usage. Further studies should be conducted on the relationship between AI anxiety and the adoption of AI technologies among undergraduates, MSTE preservice teachers, and in-service teachers, among others.

6. Declarations

Conflicts of Interest: The author declares no conflict of interest.

Data availability: Data for the study is available from the corresponding author on request.

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