

 Research Article

Technological Dispositions of Pre-Service Mathematics Teachers in Ghana: Gender Differences and Implications for Teacher Education

Enock Yeboah¹ , Fred Adusei Nsowah² , Samuel Ofori Agyeman³ 

¹School of Education, University of Wisconsin, Madison, USA

²Faculty of Education, Pentecost University, Suwotuum-Accra, Ghana

³Department of Mathematics, Konadu Yiadom Catholic SHS, Asamang-Ashanti, Ghana

Abstract

Integrating technology into teaching is essential to achieving equitable, high-quality education, particularly within the framework of Sustainable Development Goal 4. While prior research in Ghana has largely examined Information and Communication Technology (ICT) use among in-service teachers and at the senior high school level, limited attention has been given to pre-service teachers and the role of gender in shaping technological dispositions. The growing emphasis on technology integration in mathematics requires teacher preparation programs to adequately prepare future teachers with dispositions that support meaningful technology integration. Guided by the Theory of Planned Behavior, this study examined pre-service mathematics teachers' attitude or disposition towards technology integration in mathematics instruction and investigated whether this attitude differs by gender. The article reports the quantitative component of a larger sequential explanatory mixed-method study. This study examined the perspectives of 301 pre-service mathematics educators from five Colleges of Education in the Ashanti region of Ghana regarding their attitudes towards ICT integration in mathematics teaching. Data were collected from 301 participants using a structured questionnaire adapted from existing technology-related instruments and were analyzed using mean, standard deviation, and an independent *t*-test. The findings indicated predominantly unfavorable attitudes or dispositions towards ICT integration in mathematics, with participants perceiving technology as frustrating, time-consuming, and unnecessarily complicating mathematics. A statistically significant gender difference was observed, with male pre-service teachers having notably more positive attitudes than their female counterparts, $t(299) = 2.94, p = .004$, Cohen's $d = 0.34$. These findings suggest that unfavorable technological dispositions may constrain pre-service teachers' readiness to integrate technology meaningfully into mathematics instruction. The findings of this study indicate the necessity for teacher education programs to incorporate mathematics-specific technology pedagogy, tackle gender disparities in ICT confidence and engagement, and enhance institutional support for technology integration in the classroom. The study highlights critical gaps in teacher preparation for ICT integration in resource-constrained contexts.

Keywords: Gender Differences, Ghana, ICT Integration, Pre-service Mathematics Teachers, Teacher Education, Teacher Readiness

✉ Correspondence
Enock Yeboah
Yeboah2@wisc.edu

Received

June 29, 2026

Accepted

September 10, 2026

Published

October 1, 2026

Citation: Yeboah, E., Nsowah, F. A., & Agyeman, S. O. (2026). Technological dispositions of pre-service mathematics teachers in Ghana: Gender differences and implications for teacher education. *Journal of Research in Mathematics, Science, and Technology Education*, 3(4), 299–311.

DOI: [10.70232/jrmste.v3i4.98](https://doi.org/10.70232/jrmste.v3i4.98)

© 2026 The Author(s).

Published by
Scientia Publica Media



This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial License.

1. INTRODUCTION

One of the major aims of the United Nations' Sustainable Development Goal 4 (SDG 4) is to promote and achieve equitable and inclusive education to ensure lifelong learning opportunities for all (UNESCO, 2015). The integration of Information and Communication Technology (ICT) into teaching and learning aims to enhance students' academic performance in schools. The integration of ICT in schools,

among other things, motivates students, stimulates their interests, and increases their self-esteem and confidence.

Teachers' contribution to the integration of ICT in teaching is paramount; however, teachers' attitudes and demographic variables are arguably antecedents of ICT integration success (Scherer et al., 2019). In Ghana, few studies (Amponsah & Aheto, 2026; Arkorful et al., 2021) have examined the implications of attitudes, gender, and other demographic variables for ICT integration in teaching. Such a gap is hindering the implementation of formulated ICT policies in the educational sector. Resources are being channeled into ICT integration, but the real impact is still not being felt in Ghana's basic schools, where pre-service teachers are expected to teach after completing their education. It has become imperative to examine pre-service teachers' attitudes towards the integration of ICT into teaching and learning, as well as the effect of gender on teachers' attitudes towards ICT integration. In this study, technological disposition refers specifically to pre-service teachers' evaluative orientations toward using ICT in mathematics instruction, operationalized through the attitude dimension of the questionnaire.

The use of technology in secondary and tertiary education has been increasingly studied in Ghana. However, much of the focus has been on practicing teachers and students, and not on pre-service mathematics teachers. Research has shown the potential of ICT to improve mathematics learning, but also the varying levels of classroom integration and teacher preparedness (Arkorful et al., 2021; Arhin et al., 2024; Mensah & Nabie, 2021). Together, this body of literature points to the fact that access to or perceived utility of technology does not ensure meaningful integration of technology in the teaching of mathematics. However, little is known about the perception of readiness to integrate technology by pre-service mathematics teachers in Colleges of Education and whether these dispositions differ by gender. Buabeng-Andoh (2017) conducted a study at the University level that showed that students use technology for personal rather than instructional purposes. The study revealed that despite students' high acceptance of technologies, the integration of technology into learning was very low.

Dzakpasu and Adom (2017) conducted a study at the tertiary level and found that ICT had a favorable impact on the lessons delivered by lecturers to students to enhance positive outcomes. In addition, Mensah and Nabie (2021) found a significant impact of ICT integration as a teaching strategy on the achievement and motivation of Ghanaian Senior High School (SHS) students in mathematics at the senior high school level. This study employed a quasi-experimental design with pre- and post-tests to collect data from the control and experimental groups. The findings from this study show a positive impact of integrating specific ICT tools (PowerPoint presentation) on the learning outcomes of high school learners in geometry. Moreover, Arhin et al. (2024) investigated the perceptions of 90 senior high school teachers about the usefulness of ICT in mathematics and their readiness to integrate ICT in teaching and learning. The study findings revealed that ICT integration as an instructional strategy enhances students' understanding of mathematical concepts, and it is a useful tool in the teaching and learning of mathematics. The study recommended that all mathematics teachers at all levels of education integrate ICT instructional processes to improve students' learning outcomes.

At the College of Education in Ghana, there are few studies conducted on pre-service teachers' attitudes towards the integration of ICT in teaching and learning (Mensah et al., 2025) without considering gender differences and pre-service teachers' attitudes. Recent studies have indicated that pre-service teachers generally accept the pedagogical worth of ICT, but their enthusiasm to use technology in a meaningful way may depend on their preparation, prior experiences, institutional circumstances, and opportunities to interact with technology during teacher education (Mensah et al., 2025; Gbormittah et al., 2024; Essuman & Wilmot, 2024). In terms of mathematics-specific evidence, there is still a dearth of information, especially regarding pre-service mathematics teachers' dispositions and possible gender differences.

The above review of literature indicated that when it comes to ICT use in mathematics at the pre-tertiary level of education in Ghana, there is abundant literature (Agyei et al., 2022; Arhin et al., 2024; Buabeng-Andoh, 2017; Mensah & Nabie, 2021) as compared to the College of Education in Ghana, with few studies (Mensah et al., 2025). In addition, much research has focused on in-service teachers; little is known about pre-service mathematics teachers at the College of Education who are still in the process of developing their professional beliefs and instructional practices, and how their attitudes and demographic factors, such as gender, shape ICT integration.

This remains an underexplored gap in the Ghanaian literature, affecting the formulation of ICT policies in the Ghanaian educational sector. The study contributes to the literature by examining pre-service mathematics teachers' readiness toward ICT in the Colleges of Education and exploring gender differences in this readiness. Understanding pre-service teachers' readiness toward ICT integration is important because these teachers will soon enter classrooms where national policies increasingly emphasize digital learning and technology-supported instruction.

Moreover, despite policy emphasis on ICT integration in Ghana's education system, little research has examined whether teacher education programs adequately prepare pre-service mathematics teachers to integrate technology into classroom practice. This concern aligns with prior studies emphasizing that teacher readiness for ICT integration is shaped by both individual beliefs and the quality of teacher education programs (Tondeur et al., 2020). This raises critical questions about the readiness of future educators and the effectiveness of current educators' preparation structures.

This study contributes to the literature by linking pre-service teachers' ICT readiness to broader challenges in teacher education and policy implementation in developing contexts.

Therefore, the purpose of this study is to examine pre-service mathematics teachers' readiness towards ICT integration in mathematics lessons and to determine whether there are significant differences in these attitudes by gender. The study, therefore, does this by addressing the following research questions:

1. What are pre-service mathematics teachers' attitudes towards the integration of ICT in the teaching and learning of mathematics?
2. Is there a significant difference between male and female pre-service mathematics teachers' attitudes towards the integration of ICT in the teaching and learning of mathematics?

1.1. Literature Review

1.1.1. Pre-service Mathematics Teachers' Attitude toward the Integration of ICT in Teaching and Learning

The importance of pre-service teachers' technological dispositions lies in the fact that the decision to use technology for teaching is not solely based on access and technical competence, but also on beliefs, confidence, and perceptions of its instructional value. Therefore, attitudes have been regarded as an important determinant of teachers' intentions and willingness to integrate digital resources into instruction in technology-acceptance research (Ajzen 1991; Scherer et al. 2019). These dispositions are particularly important for mathematics teacher education because effective technology integration requires teachers to conceptualize electronic tools as resources for mathematical reasoning and instruction, rather than as general-purpose technologies.

Attitude is a critical factor affecting the readiness to use and the use of technology in teaching and learning in the classroom. Attitude explains how individuals believe, feel, and think about events, objects, groups of people, and human actions (Ajzen, 1991, 2006; Dunn et al., 2018). Attitudes are the behavioral beliefs (Ajzen, 1991) that affect the positive and negative outcomes of behavior (Ajzen, 2012). Attitude predicts the intentions to behave in a particular way (Ajzen, 2006; Knauder & Koschmieder, 2019). According to Ajzen (2006), attitude is determined by the person's behavioral beliefs, which relate to whether the person thinks they can perform the behavior in action. Similarly, technology adoption models such as TAM emphasize perceived usefulness and ease of use as key predictors of ICT integration (Scherer et al., 2019).

The attitude toward the behavior refers to the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question (Ajzen, 1991, 2006; Yan, 2014). Teachers' attitudes toward technology and its use in Education are another critical factor influencing technology integration. Several researchers have reported that the possibility of achieving technology integration is higher among teachers with positive attitudes (Baya'a et al., 2012; Chikasha et al., 2014). Despite their positive attitudes, teachers' in-class technology use may be low. Essuman and Wilmot (2024) indicated that teachers with a positive attitude and lower anxiety about computers would use technology effectively in teaching, while teachers with a negative attitude towards computers would resist its use in the classroom.

Chaiban and Oweini (2024) investigated the effect of teachers' experience on their attitudes towards ICT integration and their levels of classroom use, using a questionnaire administered to 204 elementary teachers. The study findings indicated a positive attitude towards ICT usage in the classroom, yet a low level of ICT usage in their classrooms and the ability to facilitate their teaching tasks. However, the study suggested that professional development in the area of ICT usage for teachers was necessary due to the low level of ICT usage in the classroom.

Çelik and Karayaman (2018) researched the attitudes of prospective mathematics teachers toward mobile learning in higher education institutions in Turkey. The study used an experimental design with a mixed-method approach. A sample size of 181 prospective mathematics teachers was selected using convenience sampling. The study found that prospective mathematics teachers had a moderate view and positive attitudes toward mobile learning. The study also revealed that male participants had a higher attitude than female participants. The study recommended examining other mathematics teachers' attitudes in different universities and encouraged teachers and students to adopt technology integration positively. This finding supports the views of Ayebi-Arthur (2010), who recommended in his study that students be encouraged to develop a positive attitude towards the use of ICT.

1.1.1.1. Gender differences and Pre-service Teachers' Attitudes towards ICT Integration in Teaching and Learning in the Classroom

Demographic characteristics such as gender have been identified as factors impacting resilience in the use of technology. However, studies on the effect of gender on technology integration in teaching and learning have been inconsistent (Qazi et al., 2022).

Gender inequalities in computer self-efficacy, like gender differences in ICT usage, have piqued the interest of the educational technology community. Previous studies have also shown that gender differences in ICT use are linked to variations in confidence, access, and social expectations (Siddiq et al., 2019). Some research found a statistically significant relationship between gender and computer self-efficacy. For example, Aremu and Fasan (2012) discovered that gender significantly predicted instructors' computer self-efficacy. Furthermore, Hong et al. (2014) revealed that male teachers exhibit significantly higher computer self-efficacy than female teachers in a study of 102 Malaysian English as a Second Language (ESL) teachers.

To corroborate this, Ozturk et al. (2011) used a descriptive survey to investigate prospective science teachers' opinions regarding gender differences in computer-related self-efficacy. The findings revealed that instructors' perceptions of computer-related self-efficacy differed significantly by gender. In contrast, Jegede (2007) discovered no gender influence on teachers' computer self-efficacy in a study designed to investigate characteristics linked with computer self-efficacy among instructors.

In Ghana, Baah and Owusu (2025) explored the demographic factors influencing science teachers' TPACK in Ghana on the roles of gender and teaching experience, using a questionnaire for 145 Junior High School science teachers. The study findings revealed a significant disparity, with male science teachers demonstrating significantly higher TPACK knowledge than their female counterparts. The study recommended professional development opportunities for teachers to address the gender gaps in the use of TPACK knowledge. Another study by Amoako and Anane (2025) assessed the moderating effect of digital teaching competence across gender and age among tutors at Colleges of Education in Ghana in the post-COVID-19 era, using data from 200 tutors. The study findings indicated no significant difference between Digital Teaching Competence (DTC) and gender.

Sarfo et al. (2017) conducted research on computer self-efficacy among senior High School Teachers in Ghana and examined the relationship between demographic variables and computer self-efficacy. The sample size for the study was 407 SHS teachers. The study used the computer self-efficacy scale developed by Teo and Koh (2010) to collect data. Descriptive statistics, *t*-tests, and univariate analyses were used to analyze the data. The results of the study indicated that teachers' gender and computer experience interact to influence their computer self-efficacy. The study used a large sample size of 400, making it reasonable for generalization. However, the generalization of the study findings is limited to the SHS and not the basic level. The universities prepare teachers at the SHS. They all have different preparation backgrounds. There is limited literature regarding gender and integration at the basic level. The study also adopted only the quantitative method. This makes it lack in-depth investigation and understanding of the problems or topic.

2. METHODOLOGY

2.1. Research Design

This article reports the quantitative component of a larger sequential explanatory mixed-method study that examined pre-service mathematics teachers' preparedness to integrate technology into their teaching. The quantitative phase employed a survey to collect standardized responses from pre-service mathematics teachers regarding ICT integration. This design was appropriate for describing participants' attitudes toward ICT integration and examining differences in responses by gender.

2.2. Participants

The total population of pre-service mathematics teachers across the five colleges of education was 1907; a sample size of 320 was selected using Krejcie and Morgan's (1970) table. A simple random sampling method was employed to select the 320 pre-service mathematics teachers from the five colleges of education in the Ashanti region of Ghana for the study (see Table 1 for details). Additionally, third-year students were selected because they had completed most of the mathematics courses. This is because they have been trained to teach mathematics using technology and have participated in peer teaching, using technology to prepare and present their lessons. The five Colleges of Education were chosen because they train mathematics and science teachers. Detailed information on pre-service mathematics teachers who participated in the study is provided in Table 2.

2.3. Research Instruments

The questionnaire used in this study was adapted from existing instruments and modified for the context of pre-service mathematics teachers in Ghana. The original Technology Acceptance Model (TAM) constructs on attitude were adopted and operationalized in this study, using measurement validity established in previous studies, with wording carefully modified to suit the context of the current study (Hossain & de Silva, 2009; Park et al., 2009). The rest of the questionnaires were adapted from Omariba (2016).

A survey was developed to examine teachers' attitudes towards ICT integration in teaching and learning in the College of Education and their level of knowledge of ICT use in classrooms. It was provided in English, as it is a mode of instruction for participants in the College of Education in Ghana. The language has not been a barrier for the participants. The questionnaire consisted of open-ended and closed-ended items to allow for varied responses. The questionnaire was organized into three sections: A, B, and C. Section A is the respondents' biographical information. Section B examines pre-service teachers' attitudes towards the integration of ICT in the classroom, and Section C examines pre-service teachers' knowledge of technology. Section B contains 12 items on the attitude of teachers towards the integration of ICT, rated on a five-point Likert-type scale (Strongly Agree =5, Agree =4, Neutral =3, Disagree =2, and Strongly Disagree =1), whereas Section C has 12 items on teacher knowledge in the use of ICT on a 5-point scale (5 = very high, 4 = high, 3 = moderate, 2 = low, and 1 = very low). In addition, there were 4 yes/no multiple-choice questions about whether their religious beliefs support and embrace the use of technology, whether they have ICT training, whether their college has a computer laboratory, and whether the College has strong internet access. Those sections were based on previously developed, reliable, and valid surveys by researchers in the literature, as one study assessed teachers' attitudes towards ICT usage in an educational setting, while the other assessed teachers' knowledge of ICT usage in the classroom.

Possible scores on the 12-item scale ranged from 12 to 60, with higher scores on negatively worded items reflecting stronger agreement with unfavorable perceptions of ICT integration. Sample items included "Working with a computer makes me nervous," "Computers are difficult to use in teaching and learning mathematics," and "I will continue to learn and use computers to teach mathematics."

To ensure that the adapted instrument was appropriate, its content and construct validity were reviewed by the first author's thesis supervisor, and it was pretested with 25 pre-service mathematics teachers. The instrument was revised, and additional items were added based on the pretest. The instrument was again pretested.

It is important to note that one of the questionnaires had an internal consistency of Cronbach's $\alpha = 0.85$ (36), and the second section C questionnaire had an internal reliability of $\alpha = 0.88$. This was to ensure the internal reliability and validity of the questionnaires, as both exceeded 0.7. A high alpha coefficient (above 0.7) is generally considered to indicate good internal consistency (George & Mallery, 2003). Additionally, George and Mallery (2003) and Kline (1999) stated that a reliability coefficient greater than 0.70 demonstrates homogeneity. Therefore, the reliability coefficients of 0.85 and 0.88 found in this study confirm that the instruments used are within the acceptable range. Table 1 shows how the 320 pre-service mathematics teachers were selected from 5 Colleges of Education.

Table 1. Distribution and Selection of the 320 Pre-service Mathematics Teachers

College	Population	Sample
A	368	$\frac{368}{1907} = 62$
B	380	$\frac{380}{1907} = 64$
C	394	$\frac{394}{1907} = 66$
D	358	$\frac{358}{1907} = 60$
E	407	$\frac{407}{1907} = 68$
Total	1907	320

Table 2 shows the demographic information of the pre-service mathematics teachers.

Table 2. Demographic Information of Pre-Service Mathematics Teachers

Variables	Frequency (%)
Gender	
Male	141(46.5)
Female	160(53.5)
Age	
20- 25 years	271(90)
26-30 years	27(9)
31-40 years	3(1)

Source: Fieldwork, 2022

2.4. Procedures

Prior to data collection, the Department of Mathematics and ICT Education at the University of Cape Coast Institutional Review Board, as well as the principals and department heads of the chosen Ghanaian colleges of education, granted ethical approval for this project. The first author contacted the pre-service math teachers, assistant academic principals, and principals at the selected colleges to invite them to join.

The prospective respondents were informed of the study's purpose before receiving the research instruments. Subsequently, a questionnaire was distributed to the respondents for completion. The study's purpose was explained to the participants, and they were given the questionnaire to complete after each item was clarified. Respondents were allowed sufficient time to respond to the questionnaire. The same procedure was followed at each of the five selected schools. On average, respondents spent one hour completing the questionnaires. A field assistant assisted in distributing the questionnaires, and department heads helped organize pre-service teachers to participate. Data collection took place over three weeks. Respondents were assured that their data would be kept confidential and that its integrity would be upheld. Data collection was conducted from May 2022 to June 2022 across the five Colleges of Education. Out of 320 questionnaires distributed, 301 were returned, resulting in a response rate of 94%.

2.5. Data Analysis

The questionnaire was entered and analysed using the Statistical Package for the Social Sciences (SPSS), version 26. To answer Research Question 1, pre-service mathematics teachers' attitudes toward integrating technology into their teaching and learning of mathematics were analysed using means and standard deviations. A five-point Likert scale was used, ranging from 1 (strongly disagree) to 5 (strongly agree). Most of the items on the attitude scale were negatively worded. For the item-level descriptive analysis, responses were interpreted along the direction of each statement, with higher scores on negatively worded items indicating greater agreement with negative perceptions of ICT integration. When assessing the composite attitude score for the gender comparison, negatively worded items were reverse-coded, so that higher composite scores meant more positive attitudes toward ICT integration.

To answer Research Question 2, the independent-samples *t*-test results were analyzed to examine the relationship between the gender of pre-service mathematics teachers and their attitude towards ICT integration in classroom teaching and learning. An independent *t*-test was conducted to determine whether there were differences in attitude by gender. Additionally, an independent *t*-test was performed to compare pre-service teachers' attitudes towards ICT integration in their learning to assess whether differences existed between males and females as pre-service mathematics teachers.

Statistical significance was evaluated at $\alpha = .05$. The gender groups were relatively large and comparable in size (male, $n = 141$; female, $n = 160$), supporting the robustness of the independent-samples *t*-test to moderate departures from normality. The group standard deviations (0.94 and 0.79, respectively) were also reasonably comparable, providing no indication of substantial variance differences between the groups.

3. RESULTS

The mean and standard deviation were calculated for pre-service mathematics teachers' attitudes towards the integration of ICT in teaching and learning. As shown in Table 3, the mean and standard deviation of pre-service mathematics teachers' attitudes towards adopting technology in teaching and learning mathematics were determined.

Table 3. Mean and Standard Deviation of Pre-service Mathematics Teachers' attitudes toward the Integration of ICT in Teaching and Learning

Statement	Mean	SD
I believe that students will not enjoy lessons when I use technology	4.19	1.090
Using technology appears to make the learning of mathematics difficult	4.15	.996
Computers make mathematics unnecessarily difficult for me to learn and teach	4.01	1.182
I feel lazy to use technology to teach or learn mathematics	3.94	1.130
Computers are difficult to use in teaching and learning mathematics	3.93	1.058
Using a computer is very frustrating	3.90	1.146
I need a lot of time to think before I use computer to teach mathematics	3.90	1.161
Working with a computer makes me nervous	3.86	1.157
I am afraid I cannot communicate with all my students using technology	3.83	1.158
I believe that using technology affects the quality of mathematics instruction	3.79	1.220
I will continue to learn and use computer to teach mathematics	3.79	1.259
Computers are difficult to use in teaching or learning	3.78	1.230
Grand mean	3.92	0.135

It was observed that the average respondents agreed with the statement, "Working with a computer makes me nervous" ($M = 3.86$, $SD = 1.157$). They also agreed that "Computers are difficult to use in teaching and learning mathematics" ($Mean = 3.93$, $SD = 1.058$) and "I feel lazy to use technology to teach or learn mathematics" ($Mean = 3.94$, $SD = 1.130$). Furthermore, pre-service mathematics teachers agreed that using a computer is very frustrating ($Mean = 3.90$, $SD = 1.146$), and they often need significant time to think before using computers to teach mathematics ($Mean = 3.90$, $SD = 1.161$). They also believed that using technology impacts the quality of mathematics instruction ($Mean = 3.79$, $SD = 1.220$). The respondents additionally agreed that they could not communicate effectively with all their students using

technology (Mean = 3.83, SD = 1.158), and that computers make mathematics unnecessarily difficult for them to learn and teach (Mean = 4.01, SD = 1.182). Moreover, the respondents concurred with the statements “using technology appears to make the learning of mathematics difficult” (Mean = 4.15, SD = .996) and “I believe students will not enjoy my lessons when I use technology” (Mean = 4.19, SD = 1.090). Overall, the mean scores (grand mean = 3.92, SD = 0.14) indicate that pre-service mathematics teachers generally hold negative attitudes toward ICT integration.

Table 4. Independent Samples *t*-Test Results on Pre-Service Mathematics Teachers’ Adoption of Technology

Gender	N	Mean	Std. Dev.	Df	<i>t</i> -value	<i>p</i> -value
Male	141	3.1883	.93953	299	2.940	.004
Female	160	2.8949	.79132			

For research question 2, the *t*-test revealed a statistically significant difference between male and female students for pre-service teachers’ attitudes towards ICT integration in teaching and learning. The mean scores for males ($M = 3.1885$, $SD = 0.9395$) were significantly higher than those for females ($M = 2.894$, $SD = 0.791$) ($t(299) = 2.94$, $p = .004$, two-tailed). The effect size (Cohen’s $d = 0.34$) suggests a small to moderate gender effect, with male pre-service teachers reporting more favourable attitudes towards ICT integration. (see Table 4 for details).

4. DISCUSSION

The study examined pre-service mathematics teachers’ readiness to integrate technology into their teaching, focusing on their attitudes, since attitudes influence readiness. This is because teachers’ attitudes towards technology are pivotal to the integration of technology in the mathematics classroom. The study findings suggest that negative attitudes towards ICT integration are not merely individual dispositions but reflect broader structural challenges within teacher education programs, including limited exposure to subject-specific technologies and inadequate institutional support. Pre-service mathematics teachers have a negative attitude towards the use of technology in mathematics instruction. This finding supports prior research suggesting that inadequate preparation in teacher education programs limits effective ICT integration despite positive policy intentions (Kaliisa & Picard, 2017; Tondeur et al., 2012).

However, recent studies in some parts of Ghana present a more varied picture. Essuman and Wilmot (2024) found a positive perception of pre-service mathematics teachers’ technology integration. They identified teacher education experiences, self-efficacy, prior experiences, and attitudes as important influences on technology integration. Similarly, Gbormittah et al. (2024) highlighted that pre-service teachers have positive attitudes towards integrating technology to study geometry. These contrasting findings suggest that technological dispositions may vary across teacher education contexts and mathematics-specific experiences, reinforcing the importance of examining the conditions under which pre-service teachers encounter and learn to use technology.

The study’s findings contradict those of Chaiban and Oweini (2024), who found that teachers had a welcoming attitude towards integrating ICT into the classroom and its ability to facilitate their teaching tasks. However, their disagreement with the training available for ICT usage in the classroom might be attributed to either inefficient or unavailable professional development opportunities provided by their school. In contrast, several studies have reported more positive attitudes towards ICT (Semerci & Aydin, 2018; Yavich & Davidovitch, 2021). For instance, a study reported highly positive attitudes among teachers towards ICT (Semerci & Aydin, 2018). This, in turn, ensures the effective use of ICT in the classroom (Teo, 2008).

In line with Ajzen’s (1991) Theory of Planned Behavior, the attitudes in question indicate unfavorable behavioral beliefs towards Information and Communication Technology (ICT) and weaker perceptions of control. Even though participants had basic ICT skills, inadequate exposure to pedagogically valuable software (e.g., GeoGebra, spreadsheets) may have reinforced the view of technology as time-consuming and frustrating.

Nevertheless, pre-service mathematics teachers’ negative attitude towards technology integration stems from the educational system. Technology was not used to teach and learn mathematics throughout

their school days. Conventional methods dominate the teaching and learning of mathematics at all levels of education; therefore, students have limited exposure to technology. Secondly, though the curriculum emphasizes the need to use technology, resources for its implementation are limited, and teachers are ill-prepared to integrate it into their instruction.

Current studies further support the importance of developing integrated technological, pedagogical, and content knowledge during teacher preparation. For example, Backfisch et al. (2024) emphasize that meaningful technology-enhanced teaching requires integrating content, pedagogical, and technological knowledge rather than technological knowledge in isolation. Similarly, studies with pre-service mathematics teachers indicate that TPACK, performance expectancy, effort expectancy, and social influences can shape intentions to continue using mathematics-specific technologies such as GeoGebra (Yildiz & Arpaci, 2024).

Results from one of the study's examinations of significant differences in gender among pre-service mathematics teachers and their adoption of technology revealed a significant difference in technology adoption between male and female pre-service mathematics teachers. The difference favors male pre-service mathematics teachers. Thus, male pre-service mathematics teachers are more likely to adopt technology in their teaching than their female counterparts. This finding aligns with the study by Çelik and Karayaman (2018), who stated that male participants have a higher attitude or rate of technology adoption than female participants. Again, the finding aligns with the study by Li & Kirkup (2007), who stated that using technology for learning is a dominant activity for males, and males have more positive attitudes toward using technology than females. It is therefore concluded that males have a higher attitude or level of technology adoption than their female counterparts.

The unfavorable dispositions observed in this study may also be understood in relation to participants' limited exposure to technology-supported mathematics instruction. Although many participants reported some technological skills, their experiences were largely limited to basic uses such as searching for information and preparing lesson notes, with less exposure to mathematics-specific technological tools. This finding is particularly important in the Ghanaian context, where recent research with pre-service mathematics teachers has identified prior experience, self-efficacy, attitudes, and teacher education programs as important factors shaping perceptions of technology integration (Essuman & Wilmot, 2024). More broadly, recent research suggests that opportunities to develop technological pedagogical knowledge and engage meaningfully with technology during teacher preparation can strengthen pre-service teachers' capacity and willingness to integrate technology into instruction (Li, 2025; Yıldiz & Arpaci, 2024). Thus, the unfavorable dispositions found in the present study may reflect not simply individual reluctance toward technology but the opportunities pre-service teachers have had to experience technology as an integral part of mathematics teaching and learning.

These findings also reinforce the need to distinguish general ICT familiarity from preparation to integrate technology pedagogically in mathematics. Recent research with pre-service mathematics teachers emphasizes the importance of developing pedagogical and mathematical content knowledge. Teacher preparation should therefore provide sustained opportunities for pre-service teachers to use mathematics-specific technologies in planning, instruction, problem-solving, and representations rather than treating technology as a separate technical skill.

5. CONCLUSION

The present study has investigated the attitudes of pre-service mathematics teachers toward the use of ICT in teaching mathematics and whether these attitudes are gender based. The findings revealed generally negative attitudes toward ICT integration, as the participants viewed technology as frustrating, difficult to use, and likely to make teaching and learning of mathematics complicated. The study also found a statistically significant gender difference where male pre-service mathematics teachers had more positive attitudes toward ICT integration than female pre-service mathematics teachers.

Pre-service mathematics teachers' technology skills were limited to using phones to search for information and laptops or computers to prepare lesson notes. They had little knowledge of other technological tools for teaching and learning mathematics, which influenced their technological disposition. Consequently, they believed their college was preparing them to integrate technology into mathematics teaching and learning. The distinction between general technological familiarity and capacity to integrate

technology pedagogically is essential. Current scholarship indicates that pedagogical content knowledge and technological knowledge jointly contribute to pre-service mathematics teachers' technological pedagogical content knowledge, while self-reported competence may not necessarily correspond closely with demonstrated knowledge (Fabian et al., 2024). This means that having access to basic technological tools and computers should not automatically be interpreted as readiness to use technology meaningfully in mathematics education

Additionally, pre-service mathematics teachers exhibited a negative attitude towards the use of technology in mathematics teaching and learning, perceiving it as frustrating and challenging. Nonetheless, male pre-service mathematics teachers held a much more positive attitude towards technology integration than their female counterparts.

Additionally, the study revealed that pre-service teachers feel lazy and find technology boring, which affects their teaching and students' enjoyment. Despite having good to excellent technological skills, they find it challenging to use computers to teach mathematics because their ability to use technology is limited to searching for information and preparing lesson notes.

The study revealed a significant difference in the adoption of technology between male and female pre-service mathematics teachers, favoring male pre-service mathematics teachers. Therefore, male pre-service mathematics teachers are more likely to adopt technology in their teaching than their female counterparts.

The findings have implications for the practical aspect of mathematics teacher education in Ghana. Teacher educators must give pre-service teachers more chances to use mathematics-specific technologies as tools for reasoning, representation, problem solving, and instruction, rather than just teaching them general technological skills as part of their ICT preparation. We encourage curriculum developers to include technology-supported mathematics pedagogy in all mathematics methods courses and field experiences. At the policy level, investment in technological infrastructure must be accompanied by systematic preparation of teacher educators and pre-service teachers for the pedagogic use of available tools. The noted gender difference also suggests the need for teacher education programs to explore equitable distribution of opportunities, confidence-building experiences, and access to technology among pre-service teachers.

There are several limitations to the current study that should be considered when interpreting the findings. First, the participants were selected from five Colleges of Education in one region of Ghana. Therefore, the results may not be representative of pre-service mathematics teachers from all the Colleges of Education in Ghana. Second, the analysis was mainly based on self-report questionnaire data. Thus, the participants' responses may reflect their perceptions of their technology disposition rather than their demonstrated ability to integrate technology into mathematics instruction and may be subject to response bias. Third, the quantitative data presented in this article were collected at a single point in time, which means that the study could not identify the development or change in technological dispositions across teacher preparation. Future research could be conducted with pre-service mathematics teachers from the Colleges of Education in different regions of Ghana using self-reported measures in combination with classroom observations, performance-based measures, or interviews. Longitudinal studies could also explore technological dispositions development in coursework and practicum experiences and the trajectories that may differ by gender.

Acknowledgments. We thank the University of Cape Coast for providing us with the necessary facilities and resources to conduct our research.

Research Ethics. This study received University of Cape Coast ethics approval on April 19, 2022 (UCC/IRB/A/2016/1331). The study was conducted in accordance with the ethical principles of the 1964 Helsinki Declaration and its later amendments or comparable ethical standards

Data Availability Statement. All data can be obtained from the corresponding author.

Conflicts of Interest. The authors declare no conflicts of interest

Funding. This research received the Samuel and Emelia Brew-Butler SGS/GRASAG, UCC Research Grant from the University of Cape Coast.

Author Contributions. Yeboah: Conceptualization, methodology, drafting the manuscript, supervision, funding acquisition, and final approval. Nsawah: Writing of the literature review, methodology, reviewing & editing, and approval. Agyeman: Critical revision of the manuscript, review & editing.

AI Statement. AI was not used to generate the content of this manuscript; however, Grammarly was used for editing. After that, we reviewed and verified the final version of our work. We take full responsibility for the content of our published work.

REFERENCES

- Agyei, E., Darko Agyei, D., & Benning, I. (2022). In-service mathematics teachers' preparedness, knowledge, skills, and self-efficacy beliefs of using technology in lesson delivery. *Cogent Education*, 9(1), Article 2135851. <https://doi.org/10.1080/2331186X.2022.2135851>
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Ajzen, I. (2006). *Constructing a theory of planned behavior questionnaire*. <https://people.umass.edu/aizen/tpb.html>
- Ajzen, I. (2012). The theory of planned behavior. In P. A. M. Lange, A. W. Kruglanski, & E. T. Higgins (Eds.), *Handbook of theories of social psychology* (Vol. 1, pp. 438–459). SAGE. <https://doi.org/10.4135/9781446249215.n22>
- Amoako, I., & Anane, E. (2025). Digital teaching competence and resilience across tutors of different age and gender in Ghana. *Discover Education*, 4, Article 89. <https://doi.org/10.1007/s44217-025-00484-9>
- Amponsah, K. D., Aheto, S. P. K., & Ocloo, P. E. D. (2026). Gender and teaching experience disparities in information and communication technology integration in early childhood education. *Cogent Education*, 13(1), Article 2592363. <https://doi.org/10.1080/2331186X.2025.2592363>
- Aremu, A., & Fasan, O. (2012). Age, gender, teaching experience, academic qualification, access to computer and computer experience as correlates of computer self-efficacy of Nigerian secondary school teachers. *International Journal of Educational Leadership*, 4(4), 147–154.
- Arhin, J., Boateng, F. O., Akosah, E. F., & Gyimah, K. (2024). Perceptions and readiness of high school mathematics teachers for integration of ICT tools in the teaching and learning of mathematics. *Pedagogical Research*, 9(1), Article em0179. <https://doi.org/10.29333/pr/14032>
- Arkorful, V., Barfi, K. A., & Aboagye, I. K. (2021). Integration of information and communication technology in teaching: Initial perspectives of senior high school teachers in Ghana. *Education and Information Technologies*, 26(4), 3771–3787. <https://doi.org/10.1007/s10639-020-10426-7>
- Ayebe-Arthur, K. (2010). Relationship between students' attitudes toward ICT and their achievement in ICT at the University of Cape Coast. *International Journal of Basic Education*, 1(2), 1–11. <https://eric.ed.gov/?id=ED538184>
- Baah, J. K., & Owusu, K. A. (2025). Junior high school science teachers' perception of their technological pedagogical content knowledge (TPACK). *Journal of Research in Mathematics, Science, and Technology Education*, 2(2), 85–102. <https://doi.org/10.70232/jrmste.v2i2.31>
- Backfisch, I., Sibley, L., Lachner, A., Kirchner, K. T., Hische, C., & Scheiter, K. (2024). Enhancing pre-service teachers' technological pedagogical content knowledge (TPACK): Utility-value interventions support knowledge integration. *Teaching and Teacher Education*, 142, Article 104532. <https://doi.org/10.1016/j.tate.2024.104532>
- Baya'a, N., & Daher, W. (2012). Mathematics teachers' readiness to integrate ICT in the classroom: The case of elementary and middle school Arab teachers in Israel. In *Proceedings of the 2012 International Conference on Interactive Mobile and Computer Aided Learning* (pp. 173–179). <https://doi.org/10.1109/IMCL.2012.6396470>
- Buabeng-Andoh, C. (2017). An investigation of educational use of information and communication technology from the perspectives of Ghanaian students. *International Journal of Information and Communication Technology Education*, 13(3), 40–54. <https://doi.org/10.4018/IJICTE.2017070104>
- Çelik, H. C., & Karayaman, S. (2018). Investigating attitudes of prospective mathematics teachers towards the use of mobile learning at a higher learning institution. *Universal Journal of Educational Research*, 6(8), 1784–1794. <https://doi.org/10.13189/ujer.2018.060823>
- Chaiban, T., & Oweini, A. (2024). Assessing post-COVID-19 Lebanese teachers' attitudes towards ICT and their level of integration in the classroom in relation to their years of experience. *Heliyon*, 10(18), Article e38266. <https://doi.org/10.1016/j.heliyon.2024.e38266>
- Chikasha, S., Ntuli, M., Sundarjee, R., & Chikasha, J. (2014). ICT integration in teaching: An uncomfortable zone for teachers: A case of schools in Johannesburg. *Education as Change*, 18(1), 137–150. <https://doi.org/10.1080/16823206.2013.847013>

- Dunn, R., Hattie, J., & Bowles, T. (2018). Using the theory of planned behavior to explore teachers' intentions to engage in ongoing teacher professional learning. *Studies in Educational Evaluation*, 59, 288–294. <https://doi.org/10.1016/j.stueduc.2018.10.001>
- Dzakpasu, P. E., & Adom, D. (2017). Impact assessment of information and communication technologies on lesson delivery and students' performance in selected tertiary institutions in Ghana. *Journal of Computer Sciences and Applications*, 5(1), 29–41. <https://doi.org/10.12691/jcsa-5-1-5>
- Essuman, S. A., & Wilmot, E. M. (2024). Perceptions of technology integration in algebra instruction among pre-service mathematics teachers: A case study in the Upper East region of Ghana. *Cogent Education*, 11(1), Article 2319442. <https://doi.org/10.1080/2331186X.2024.2319442>
- Fabian, A., Fütterer, T., Backfisch, I., Lunowa, E., Paravicini, W., Hübner, N., & Lachner, A. (2024). Unraveling TPACK: Investigating the inherent structure of TPACK from a subject-specific angle using test-based instruments. *Computers & Education*, 217, Article 105040. <https://doi.org/10.1016/j.compedu.2024.105040>
- Gbormittah, D., Korsah, D. P., Osiakwan, J. K., & Adom, G. (2024). Perceived attitude of preservice teachers towards the integration of technology in teaching and learning college geometry: cases of two selected colleges of education in Ghana. *Discover Education*, 3(1), Article 150. <https://link.springer.com/article/10.1007/s44217-024-00149-z>
- George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference, 11.0 update* (4th ed.). Allyn & Bacon. <https://www.scribd.com/document/338206972/George-and-Mallery-2003-pdf>
- Hong, K. S., Chai, M. L., Tan, K. W., Hasbee, U., & Ting, L. N. (2014). ESL teachers' computer self-efficacy, attitudes toward computer and classroom computer use. *Pertanika Journal of Social Sciences & Humanities*, 22(2), 369–385.
- Hossain, L., & de Silva, A. (2009). Exploring user acceptance of technology using social networks. *The Journal of High Technology Management Research*, 20(1), 1–18. <https://doi.org/10.1016/j.hitech.2009.02.005>
- Jegede, P. O. (2007). Factors in computer self-efficacy among Nigerian College of Education teachers. *Journal of Psychology in Africa*, 17(1), 39–44. <https://doi.org/10.1080/14330237.2007.10820142>
- Kaliisa, R., & Picard, M. (2017). A systematic review on mobile learning in higher education: The African perspective. *Turkish Online Journal of Educational Technology*, 16(1), 1–18. <https://researchportal.murdoch.edu.au/esploro/outputs/journalArticle/A-systematic-review-on-mobile-learning/991005542880207891/filesAndLinks?i ndex=0>
- Kline, P. (1999). *The handbook of psychological testing* (2nd ed.). Routledge. [https://www.google.com/books/edition/Handbook_of_Psychological_Testing/JggVAgAAQBAJ?hl=en&g bpv=1&dq=Kline,+P.+\(1999\).+The+handbook+of+psychological+testing+\(2nd+ed.\).+Routledge.&pg=P P1&printsec=frontcover](https://www.google.com/books/edition/Handbook_of_Psychological_Testing/JggVAgAAQBAJ?hl=en&g bpv=1&dq=Kline,+P.+(1999).+The+handbook+of+psychological+testing+(2nd+ed.).+Routledge.&pg=P P1&printsec=frontcover)
- Knauder, H., & Koschmieder, C. (2019). Individualized student support in primary school teaching: A review of influencing factors using the theory of planned behavior (TPB). *Teaching and Teacher Education*, 77, 66–76. <https://doi.org/10.1016/j.tate.2018.09.012>
- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607–610. <https://doi.org/10.1177/001316447003000308>
- Li, H. (2025) Integrating ICT in education: A scoping review of pre-service teachers' ICT beliefs. *PLoS ONE*, 20(2), Article e0317591. <https://doi.org/10.1371/journal.pone.0317591>
- Li, N., & Kirkup, G. (2007). Gender and cultural differences in Internet use: A study of China and the UK. *Computers & Education*, 48(2), 301–317. <https://doi.org/10.1016/j.compedu.2005.01.007>
- Mensah, J. Y., & Nabie, M. J. (2021). The Effect of PowerPoint Instruction on High School Students' Achievement and Motivation to Learn Geometry. *International Journal of Technology in Education*, 4(3), 331–350. <https://doi.org/10.46328/ijte.55>
- Mensah, J. Y., Hokor, E. K., Sallah, E. K., & Sam, S. E. (2025). Investigating pre-service elementary teachers' use and perceptions about ICT integration in mathematics education. *EIKI Journal of Effective Teaching Methods*, 3(1). <https://doi.org/10.59652/jetm.v3i1.451>
- Omariba, A. (2016). *Teachers' preparedness in integrating information communication technology in training teachers in public primary teacher training colleges in Central Region Kenya* [Doctoral dissertation, Kenyatta University]. Kenyatta University Institutional Repository.
- Ozturk, N., Bozkurt, E., Kartal, T., Demir, R., & Ekici, G. (2011). Evaluation of prospective science teachers' computer self-efficacy. *Western Anatolia Journal of Educational Science*, 1, 181–187. <https://acikerisim.sinop.edu.tr/server/api/core/bitstreams/6df725f4-0443-4748-817c-c6eb5856e5ec/content>

- Park, N., Roman, R., Lee, S., & Chung, J. E. (2009). User acceptance of a digital library system in developing countries: An application of the technology acceptance model. *International Journal of Information Management*, 29(3). <https://doi.org/10.1016/j.ijinfomgt.2008.07.001>
- Qazi, A., Hasan, N., Abayomi-Alli, O., Hardaker, G., Scherer, R., Sarker, Y., et al. (2022). Gender differences in information and communication technology use & skills: A systematic review and meta-analysis. *Education and Information Technologies*, 27(3), 4225–4258. <https://doi.org/10.1007/s10639-021-10775-x>
- Sarfo, F. K., Amankwah, F., & Konin, D. (2017). Computer self-efficacy among senior high school teachers in Ghana and the functionality of demographic variables on their computer self-efficacy. *Turkish Online Journal of Educational Technology*, 16(1), 19–31. <https://eric.ed.gov/?id=EJ1124909>
- Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach. *Computers & Education*, 128, 13–35. <https://doi.org/10.1016/j.compedu.2018.09.009>
- Semerçi, A., & Aydın, M. K. (2018). Examining high school teachers' attitudes towards ICT use in education. *International Journal of Progressive Education*, 14(2), 93–105. <https://doi.org/10.29329/ijpe.2018.139.7>
- Siddiq, F., & Scherer, R. (2019). Is there a gender gap? A meta-analysis of the gender differences in students' ICT literacy. *Educational Research Review*, 27, 205–217. <https://doi.org/10.1016/j.edurev.2019.03.007>
- Teo, T. (2008). Pre-service teachers' attitudes towards computer use: A Singapore survey. *Australasian Journal of Educational Technology*, 24(4). <https://doi.org/10.14742/ajet.1201>
- Tondeur, J., Scherer, R., Siddiq, F., & Baran, E. (2020). Enhancing pre-service teachers' technological pedagogical content knowledge (TPACK): A mixed-method study. *Educational Technology Research and Development*, 68(1), 319–343. <https://doi.org/10.1007/s11423-019-09692-1>
- Tondeur, J., Van Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education*, 59(1), 134–144. <https://doi.org/10.1016/j.compedu.2011.10.009>
- UNESCO. (2015). *Education 2030: Incheon Declaration and Framework for Action towards inclusive and equitable quality education and lifelong learning for all*. UNESCO. https://uite.unesco.org/publications/education-2030-incheon-declaration-framework-action-towards-inclusive-equitable-quality-education-lifelong-learning/?utm_source=chatgpt.com
- Yan, Z. (2014). Predicting teachers' intentions to implement school-based assessment using the theory of planned behavior. *Educational Research and Evaluation*, 20(2) 83–97. <https://doi.org/10.1080/13803611.2013.877394>
- Yavich, R., & Davidovitch, N. (2021). Teachers' attitudes to use of advanced technological tools as teaching and learning aids: from an inter-generational perspective. *The European Educational Researcher*, 4(3), 329–354. <https://doi.org/10.31757/euer.434>
- Yildiz, E., & Arpaci, I. (2024). Understanding pre-service mathematics teachers' intentions to use GeoGebra: The role of technological pedagogical content knowledge. *Education and Information Technologies*, 29(14), 18817–18838. <https://doi.org/10.1007/s10639-024-12614-1>