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Research Article

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Using UTAUT model to assess the factors influencing the use of ICT in Ghanaian pre-tertiary mathematics education

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ABSTRACT

As the demand for acquiring Information communication and technology has increased rapidly due to the exponential growth of technological advancement in all human endeavor, researchers are also developing theories and/or models that could be used to describe and prognosticate humans' espousal and use of these technologies as they are being released in the markets. The present study adapted one of the powerful models for information and communication technology (ICT) integration (thus, unified theory of acceptance and technology use) to assess pre-tertiary mathematics facilitators' intentions and actual use of ICT for mathematics instructions in Ghana. This study adopts a quantitative research approach with a questionnaire as a survey instrument for collecting 185 valid data from both junior and senior high schools' mathematics facilitators. Descriptive statistics and an enter multiple regression were deployed to validate the proposed research questions. Using SPPS v.23 as a statistical software for analyzing the data, the result reveals that, performance expectancy, and effort expectancy had a positive and significant effect on mathematics facilitators' intentions toward ICT adoption. Moreover, social influence was significant but had a negative impact on facilitators intentions. The impact of mathematics facilitators' intention to use ICT and the facilitating conditions (FCs) within the school environment was also a positive and significant predictor of facilitators' ICT use behavior. It was concluded from the findings that FCs were the better predictor for mathematics teachers' ICT use behavior than intention. Hence, the researchers recommended that more government expenditure must be allocated to infrastructures that would improve the use of ICT as well as frequent ICT training must be undertaken to enrich teachers' knowledge in the affordance of using ICT in mathematics classrooms.

Keywords: Ghanaian pre-tertiary education, instructional technologies, mathematics education, pre-tertiary mathematics facilitators, unified theory of acceptance and technology use

INTRODUCTION

Information and communication technology (ICT) as defined by Ruiz et al. (2022) is the computers, software, satellite links, networks, and systems that assist individuals in obtaining, analyzing, creating, sharing, and using information and data. From the perspective of educationalists, ICT usage is vital for promoting an inclusive and quality education. Recent instructional technology has been proven to have helped create interactive classroom learning, which has positively influenced students' understanding of scientific and/or complex concepts and mathematics performance (Das, 2019). According to the National Council of Teachers of Mathematics (2000), the accessibility of educational technology has improved mathematics instruction. The importance of certain mathematical ideas and concepts has been raised by ICT in mathematics education, and it has provided new approaches to representing and handling mathematical information providing choices about content and pedagogy, which has become new (Zakaria & Khalid, 2016).

Based on the improvement in the education sector through ICT integration, the global world has heavily invested in technological tools to further enhance the teaching and learning process. In a developing country like Ghana, successive governments have fostered the spread of technology in schools, particularly at pre-tertiary levels. In 2003, a huge revolution was experienced in the Ghanaian educational sector from the framework of ICT for accelerated development policy. The policy was designed to provide quality education to Ghanaian citizens within the various geographical coordinates of the country. Further initiatives were taken by successive governments and in 2011 government provided free laptops to teachers and students at

the post-primary schools and tertiary sectors. Again, in 2017, the Ghanaian senior high schools (SHSs) across the country experienced a free Wi-Fi distribution to enhance free internet access. However, the policy of free Wi-Fi largely benefited urban schools as compared to rural schools since rural schools have inadequate infrastructure to support its successful implementation (Agyei & Voogt, 2011).

The deadly COVID-19 virus has given more room for the importance of ICT integration in various aspects of man's life of which the educational sector cannot be left out. In curbing the rapid speed of the virus, social distancing was given the most priority than any other factor. This led organizations to rearrange work duties for their staff to be carried out from home via communication technology (Mustajab et al., 2020; Vyas & Butakhieo, 2021). Similarly, schools were closed down to prevent human interactions, and institutions especially schools were heavily relying on ICT to provide education to students online (Owusu-Fordjour et al., 2020; Tomasik et al., 2021).

The use of online platforms in education had proven to enhance the teaching and learning processes (Yuen & Ma, 2008). One challenge of online learning is the direct interaction between teacher-students and student-students (Mayer, 2019). However, a creative teacher can make online lessons as efficient as face-to-face (Jefferson & Paul, 2019). By prioritization of online education during the COVID-19 and post-COVID-19 pandemic era, teachers' acceptance of ICT in teaching-learning becomes crucial for the successful incorporation of technology in education. Hence, the current study focused on teachers' adoption of ICT in teaching mathematics at the pre-tertiary education levels in Ghana.

Different strategies and approaches have been documented in the literature for improving the quality of education (Budiharso & Tarman, 2020; Harrison et al., 2022). Regarding mathematics education, similar studies have been conducted that focused on the nature of the school curriculum, learning conditions, parental involvement, and standardization in students' evaluation (Kumar-Jaiswal, 2017; Sievertsen et al., 2016; Tyas & Naibaho, 2021; Verger et al., 2019). In light of this, the acceptance of technology by teachers and its utilization in mathematics instruction has received few empirical investigations (Luo & Teo, 2011).

Past and present literature have shown that ICT adaptation encourages inclusive education, promotes gender equality as well as enhances students' achievement (Foutsitzi & Caridakis, 2019; Kul et al., 2018). Even though, there are numerous benefits derived from ICT use by teachers, Aydin and Gurol (2019) discovered that switching from traditional techniques of teaching or modifying traditional approaches to teaching to ICT-embedded instruction is not easy. They further added that teachers need effective and efficient strategies to effectively infuse ICT in schools. Constant studies have demonstrated that mathematics instructions integrated with technology increase students' participation, develop students' thinking abilities, improve students' problem-solving skills, facilitate students' understanding of mathematical concepts as well as enhance students' general performance (McGehee & Griffith, 2020).

Despite the benefits of ICT integration in mathematics education, studies from developing countries have shown that few teachers are truly integrating ICT into mathematics instruction (Agyei & Voogt, 2011). This calls for constant investigation into the factors that might positively influence such teachers' adaptation of ICT in the teaching and learning of mathematics (Ince-Muslu & Erduran, 2020; Perienen, 2020). However, factors such as teachers' pedagogical beliefs, computer anxiety, and attitudes of teachers have been considered crucial hurdles to ICT integration in education (Ruiz et al., 2022). Hence, the present study used a modified version of unified theory of acceptance and use of technology (UTAUT) developed by Venkatesh et al. (2003) to examine mathematics teachers' adaptation of ICT in classrooms.

The application of UTAUT in examining teachers' adoption of technology in educational institutions has gained numerous studies. Wijaya et al. (2022) examined mathematics facilitators' acceptance of micro-teaching by applying the original UTAUT model in China. Saal et al. (2020) used a qualitative study to assess the application of ICT based on the framework of UTAUT in South Africa. In analyzing both teachers' and students' acceptance of Android applications for teaching and learning mathematics in Indonesia, Mandailina et al. (2019) used UTAUT as a conceptual framework. Al-zboon et al. (2021) employed the factors of UTAUT to examine mathematics and science teachers' attitudes towards ICT usage in classrooms. This current study, therefore, contributes to the validation of UTAUT model in the Ghanaian pre-tertiary educational context by assessing mathematics facilitators' acceptance of ICT incorporation in their overall educational practices.

A meaningful understanding of the factors that promote mathematics facilitators' acceptance and use of ICT in Ghanaian education settings is important as many instructional technologies have proven influential in the teaching-learning processes. According to Raj-Joshi (2017), instructional technology is very important for the study of mathematical concepts like geometry, calculus, algebra, and statistics. Technology is essential for learning as it provides the student with quick feedback, regulates curiosity in learners, encourages fun-based learning, and provides comprehensive knowledge exchange (Das, 2019). Even though successive governments have invested largely in ICT to strengthen the Ghanaian educational system for some decades now, findings from Agyei and Voogt (2011) indicated countless issues associated with the adoption and diffusion of ICT in Ghanaian classrooms. The teacher is required not only to know about specific technology but also knowledge of technological usefulness and the constraints associated with using ICT (Khambari et al., 2010). Therefore, recent studies have intensified a shift from the benefit of ICT integration in education to examining the influential factors that will possibly promote teachers' ICT acceptance and use for instructional purposes. It is on this note that the researchers utilized a modified version of UTAUT model to assess the possible factors that can enhance pre-tertiary mathematics facilitators' acceptance and use of ICT in instructions.

Purpose of the Study

The rationale of this study was to assess the factors influencing pre-tertiary mathematics facilitators' adoption and use of ICT for mathematics instruction. Specifically, the objectives that guarded the study are outlined.

1. To assess the impact of performance expectancy (PE), effort expectancy (EE), and social influence (SI) on pre-tertiary mathematics teachers' behavioral intentions (BIs) to adopt ICT in mathematics instruction.
2. To examine the influence of BIs and facilitating conditions (FCs) on Ghanaian pre-tertiary mathematics facilitators' user behavior toward ICT integration.

Research Questions

The study tried to respond to the accompanying questions.

1 What is the impact of PE, EE, and SI on pre-tertiary mathematics teachers' BIs to adopt ICT in mathematics instruction?

2 What is the influence of BIs and FCs on Ghanaian pre-tertiary mathematics facilitators' user behavior toward ICT integration?

THEORETICAL FRAMEWORK

The current study adapted UTAUT model to assess pre-tertiary mathematics facilitators' espousal and use of technology for instructional purposes in mathematics classrooms in Ghana. UTAUT model was chosen among the equally important technology integration models due to the combination of eight different models. This means that UTAUT model developed by Venkatesh et al. (2003) combines eight different models to form one model. These eight models are the theory of reasoned action, motivational model, theory of planned behavior (TPB), technology acceptance model (TAM), model of PC utilization, innovation diffusion theory, social cognitive theory, and combined TAM and TPB (C-TAM-TPB). UTAUT has been used extensively by researchers and has proven to be reliable and valid for predicting technology or innovation acceptance or adoption by an individual, group, or organization (Chen, 2011; Lee & Xie, 2018; Luhamya et al., 2017; Perienen, 2020).

Venkatesh et al. (2003) developed UTAUT to understand and predict user adoption and usage behavior of innovation. UTAUT model as said earlier combines various theories and information systems to provide a comprehensive framework for apprehending innovation adoption. UTAUT model identifies four key factors that influence user acceptance and usage behavior (Venkatesh et al., 2003). The four vital factors are PE, EE, SI, and FCs. UTAUT model also incorporates four factors that moderate PE, EE, SI, and FC. The moderators are age, voluntariness to use, experience, and gender (Venkatesh et al., 2003).

According to UTAUT model, PE defines the extent to which an individual believes that using an innovation will enhance job performance (Venkatesh et al., 2003). It is the main component that affects user intention. PE is based on the user's perception of the usefulness of the technology. If the user perceives that using innovation will improve their productivity, or improve outcomes, they are more likely to accept and use the technology. PE is also influenced by various factors such as the user's prior exposure to similar technologies, their understanding of how the technology works, and their expectation of the benefits it can provide (Chen, 2011). The easier it is for the user to see the potential benefits and advantages of using the technology, the higher their PE will be.

EE defines the level of convenience or effortlessness the user gains in using an innovation. EE is based on individual perceptions of the easiness of technology. If the user thinks that using the innovation can be straightforward, and intuitive, and does not need much mental or physical effort, they are more likely to accept and use the technology (Luhamya et al., 2017). EE may be affected by prior experience, familiarity with the user interface, and trust in what they can do to learn and use the innovation productively. The more convenient and intuitive the innovation is perceived to be, the higher EE will be.

SI in UTAUT model defines the social or environmental impact on the user to perform a particular task (Venkatesh et al., 2003). SI is also based on the individual's view of the norms and expectations surrounding the use of technology within their social environment. If an individual perceives that their peers or superiors view the technology as important or necessary, they are more likely to adopt and use the innovation. The individual's perception of what others expect from them and the importance they attach to meeting those expectations can influence their decision to adopt and use the technology (Wijaya et al., 2022). Moreover, other social factors such as social support, social networks, and social presence can also influence SI. For example, if an individual receives support and encouragement from their colleagues or if they have strong social connections within the organization, it can positively impact their SI and increase the likelihood of innovation adoption (Perienen, 2020; Venkatesh et al., 2003).

In UTAUT model, FCs define organizational resources, and support that the user believes is available to use innovation (Venkatesh et al., 2003). FC encompasses the technical and organizational infrastructure necessary for the successful acceptance and use of innovation. This included factors such as the availability of technical support, training, adequate hardware and software, and compatibility with existing systems (Al-zboon et al., 2021; Venkatesh et al., 2003). If the user perceives that the necessary resources and support are readily available, they are more likely to adopt and use the innovation. On the other hand, if they perceive a lack of resources or inadequate support, it can hinder their adoption and usage of the technology. FC can also include organizational policies, management support, and the overall culture of the organization. If the organization encourages and supports the use of technology, it can positively influence FC and increase the likelihood of technology adoption.

Additionally, UTAUT considers four moderators as earlier mentioned that affect the relationship between the four key factors and the user intention to use innovation. These moderating factors are explained, as follows:

1. **Gender:** Research has shown that gender can moderate the relationship between UTAUT factors and

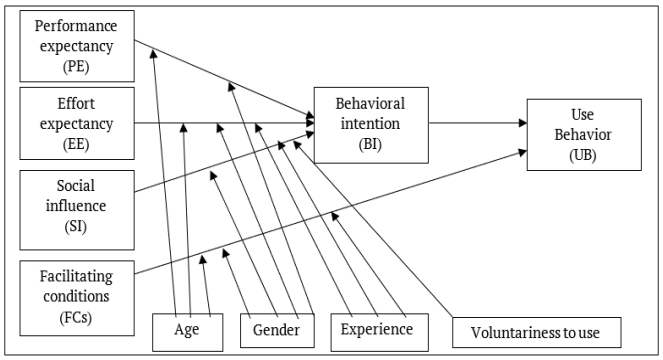

Figure 1. UTAUT (Venkatesh et al. 2003).

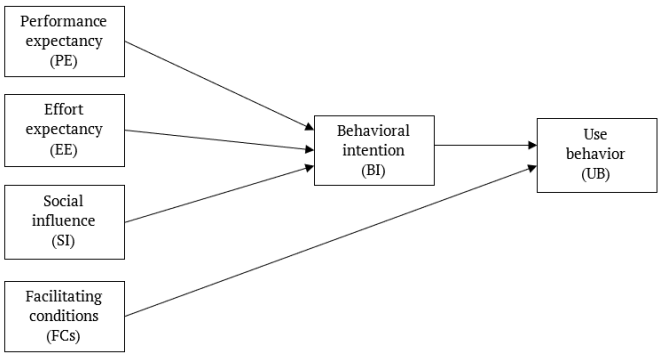

Figure 2. Conceptual framework (Source: Authors)

innovation acceptance. For example, men may be more influenced by PE, while women may be more influenced by SI (Venkatesh et al., 2003).

2. **Age:** Age can play a role in determining technology adoption and usage patterns. Younger individuals may be more open and adaptive to new technologies while older individuals may exhibit resistance due to unfamiliarity or lack of PE (Venkatesh et al., 2003)..
3. **Experience:** Individuals with prior experience using similar technologies may be more accepting and comfortable with adopting new technology. Experience can influence EE and PE (Venkatesh et al., 2003).
4. **Voluntariness of use:** When technology use is voluntary and not imposed, users are more likely to accept and utilize it compared to situations, where usage is compulsory (Venkatesh et al., 2003).

UTAUT gives a comprehensive model for understanding individuals' intentions to accept and use technology. It has been extensively applied and validated in various contexts and has contributed significantly to the field of technology acceptance research. Researchers have found the model to be effective in explaining and predicting technology acceptance behavior (Lee & Xie, 2018; Luhamya et al., 2017; Mandailina et al., 2019). As UTAUT model has been commonly used and applied in settings including healthcare, education, e-commerce, and institution, understanding and applying UTAUT framework can have practical implications for technology design, implementation, and user adoption strategies. It can assist institutions in identifying the barriers and enablers of technology acceptance, allowing them to develop targeted interventions and strategies to promote successful technology adoption and use. **Figure 1** represents UTAUT model as proposed by Venkatesh et al. (2003).

RESEARCH FRAMEWORK

Using the modified version of UTAUT model in this present study implies that the model will provide a comprehensive and holistic approach to understanding technology acceptance and adoption by Ghanaian mathematics facilitators at the pre-tertiary level of education. By considering the multiple factors and their interrelationships, the model will offer valuable insight into the complex dynamics of user acceptance and usage behavior, ultimately supporting effective technology implementation and utilization for Ghanaian pre-tertiary mathematics education across the country. Hence, the current study applied an altered version of UTAUT model to assess teachers' use of instructional technology for pre-tertiary mathematics education in the Ashanti Region of Ghana. **Figure 2** depicts the conceptual framework for the study.

METHODOLOGY

Research Paradigm & Design

A paradigm is a philosophical way of thinking as first used by Kuhn in 1962. For educational researchers, paradigm describes the researcher's worldview' (Mackenzie & Knipe, 2006). According to Kivunja and Kuyini (2017), this worldview is a set of beliefs shared that gives meaning to research data. The research paradigm helps to establish a major philosophical, methodological, and some dimensional basis for the study (Kivunja & Kuyini, 2017). Among the various paradigms such as pragmatism, post-positivism, interpretative, and positivism, the present study chooses the positivism paradigm as the most appropriate paradigm. Positivism is a paradigm that involves data-gathering processes that can be analysis in quantitatively (Aliyu et al., 2014). This paradigm was chosen on the basis that the design of the study adopts a quantitative approach and considers the fact that a chosen quantitative approach has numerous merits in the context of mathematics facilitators' acceptance of ICT. According to Scherer et al. (2019), the behavioral facet can reasonably be discovered through quantitative design with a survey questionnaire.

Participants

The sample size for the investigation was 185 pre-tertiary mathematics teachers within the Kumasi Metro. The study used convenience and purposive sampling techniques to select 91 mathematics teachers in junior high school (JHS), and 94 mathematics teachers in SHS. In all, five JHS and three SHS were sampled for data collection.

Data Instrument, Collection, & Analysis

A self-administered paper-based questionnaire was utilized for data collection. A self-administered questionnaire is a self-report information-gathering instrument that each research respondent fills out as part of a research study (Christensen, 2015). These variables were adapted from the works of Venkatesh et al. (2003) and Wijaya et al. (2022).

Table 1. Participants' gender (Field Data, 2023)

Gender		Frequency (n)	Percentage (%)
JHS	Male	89	97.8
	Female	2	2.2
	Total	**91**	**100**
SHS	Male	86	91.5
	Female	8	8.5
	Total	**94**	**100**
C-HS	Male	175	94.6
	Female	10	5.4
	Total	**185**	**100**

Note. C-HS: Combined JHS & SHS

Every statement was measured on a 5-Likert scale with 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree. Beglar and Nemoto (2014) suggested the utilization of the Likert type of scale in educational research, because of its high legitimacy.

Two parts were used for the questionnaire development. The first part was used to measure UTAUT variables while the second part was used to gather information on the participant demographic. The survey questionnaire was developed to be answered within a limit of 10-15 minutes to maximize the completed response rate and minimize the effect on the time of the participant. The participants were given the survey questionnaire and requested to fill it in their own time and return it for collection by the researchers after a week of distribution.

For validity purposes, the survey questionnaire was designed in line with UTAUT acceptance instruments. The instrument measures four independent variables and two dependent variables (one variable is the mediator). Two experienced lecturers in the field of mathematics education at AAMUSTED were given the questionnaire to assess the content validity and the ambiguity of the words and how comprehensive they were in assessing the intended research work. Cronbach's alpha test was employed to validate the internal consistency of UTAUT variable utilized for the current study. The alpha coefficient assists in deciding the reliability of the items and coefficients above 0.70 mean that the instruments have consistency as explained by Taber (2018). The alpha score for the questionnaire was 0.8 and this showed that the instruments were reliable. Four lecturers also went through the survey questionnaire to check consistency.

Two statistical analysis stages were used during the data analysis. The first stage provided details on the descriptive statistics of the respondents and the second stage dealt with the inferential statistics containing an enter multiple regression analysis to assess the proposed research questions of UTAUT model with a significant level of 0.05. However, tables were used to present the findings of the study, where necessary.

RESULTS

Table 1 shows the number of males and females who responded to the survey questionnaire. In all, the males were 175 representing 94.6% of the sample and the female were 10, representing 5.4% of the sample. From JHS perspective, the male participants were 89, representing 97.8% and the female participants were two, representing 2.2% of the sample for the study. Again, based on the sample of respondents from SHS, 86 representing 91.5% were males and eight representing 8.5% were females. The number of males who took the study was more than the number of females. This clearly shows that males are still dominant in pursuing mathematics.

Table 2. Participants age, teaching qualification, teaching experiences, & ICT integration experience (Field Data, 2023)

Demography	Category	Frequency (n)	Valid percentage (%)
Age	21-26	23	12.4
	26-30	26	14.1
	31-35	42	22.7
	36-40	44	23.8
	41-45	21	11.4
	>45	29	15.6
	Total	**185**	**100**
Teaching qualification	Diploma	65	35.1
	HND	2	1.1
	Degree	102	55.1
	Masters	16	8.6
	PhD	-	-
	Total	**185**	**100**
Teaching experience	0-4	13	7.0
	5-10	27	14.6
	11-15	39	21.1
	16-20	46	24.9
	21-25	38	20.5
	>25	22	11.9
	Total	**185**	**100**
ICT integration experience	0-4	5	2.7
	5-10	12	6.5
	11-15	36	19.5
	16-20	64	34.6
	21-25	59	31.9
	>25	9	4.9
	Total	**185**	**100**

The age group for the participants from **Table 2** were 21-26, 26-30, 31-35, 36-40, 41-45, and above 45. They are of equal intervals of five years. Participants between the ages of 21-26 years were 23, representing 12.4%. 26 of them were between the ages of 26-30 years and that was 14.1%. For the ages of 31-35 years, they were 42 representing 22.7%. 44 of them were between 36-40 years, which was the highest with 23.8%. Participants between the age of 41-45 were 21, representing 11.4%. From the sample of 185 participants, only 29 were above 45 years and that represents 15.6%.

For any professional teacher in the Ghanaian education sector, the minimum requirement for JHS teachers is a diploma in education and for that of SHS is a degree. However, requirements such as HND, master's, or higher certificates can equally be used. From **Table 2**, 65 of the participants have a diploma certificate, which represents 35.1%. Two representing 1.1% have HND. For the Degree, they were the highest with 102 and a percentage of 55.1%. Master's certificate holders were 16, which represents 8.6% and none of the respondents holds a PhD certificate.

Table 2 further shows the experiences teachers at the pre-tertiary level have in mathematics instruction. Out of the 185 participants, 13 representing 7.0% had the lowest teaching

Table 3. Influence of PE, EE, & SI on BI towards ICT usage

Model	Unstandardized coefficients		Standardized coefficients	t	Sig	R^2
	B	Standard error	Beta			
PE	1.042	.218	.799	4.774	.000	
EE	.557	.096	.402	5.793	.000	.577
SI	-.501	.224	-.364	-2.240	.027	

Note. Predicted variable: BI & Predictor variable: PE; EE; & SI

Table 4. Impact of BI & FCs on UB

Model	Unstandardized coefficients		Standardized coefficients	t	Sig	R^2
	B	Standard error	Beta			
BI	.338	.052	.370	6.511	.000	.465
FCs	.467	.062	.431	7.576	.000	

Note. Predicted variable: Use behavior (UB) & Predictor variable: BI & FCs

experience from 0-4 years. The experiences of teachers teaching between 5-10 years were 27 representing 14.6%. 39, which represent 21.1% were 11-15 years of experience in teaching mathematics. From 16-20 years, 46 of the participants representing 24.9% claimed to have experience in teaching mathematics. Moreover, 38 representing 20.5% were experienced within 21-25 years and 22 representing 11.9% were above 25 years of teaching experience.

From **Table 2**, five representing 2.7% of the mathematics facilitators reported to have 0-4 years of experience in integrating ICT into mathematics instructions. Between 5-10 years of ICT integration experience were 12 representing 6.5%. 36, which represent 19.5% of participants of the study have 11-15 years of experience in ICT integration. From 16-20 years of ICT integration experience, 64 of the participants representing 34.6% claimed to have experience in instructional technology integration, which is the highest among the participants sampled for the study. Moreover, 59 representing 31.9% of the mathematics teachers were experienced within 21-25 years in using ICT for pedagogical purposes, and nine representing 4.9% had more than 25 years of ICT integration experience.

Research Question One

The first research question for the study is specifically aimed at determining pre-tertiary mathematics facilitators' BIs towards ICT usage based on PE, EE, and SI. To achieve this, the researcher applied an enter multiple regression analysis technique, where three independent variables were regressed on one dependent variable. **Table 3** shows the results of:

i. the influence of PE on pre-tertiary mathematics facilitators' intentions toward ICT use.

ii. the influence of EE on pre-tertiary mathematics facilitators' intentions toward ICT use.

iii. the influence of SI on pre-tertiary mathematics facilitators' intentions toward ICT use.

The result from **Table 3** revealed that PE has a positive significant impact on pre-tertiary mathematics teachers' BI toward ICT usage (β=.799, p<.000). The results from **Table 3** further show that EE (β=.402, p<.000) has a direct positive effect on pre-tertiary mathematics teachers' BIs towards ICT usage.

Table 3 also revealed that SI (β=-.364, p<.027) has a negative influence on pre-tertiary mathematics teachers' BIs towards ICT usage. Moreover, PE, EE, and SI was able to explain 57.7% of the variance for predicting BI.

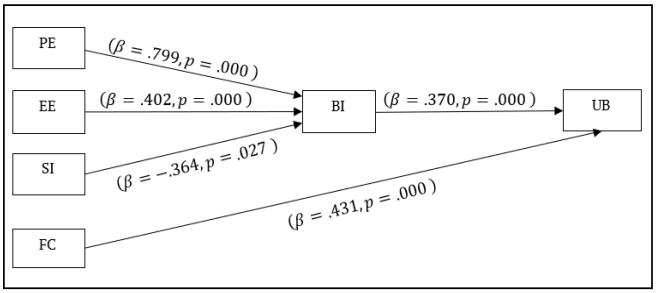

Figure 3. Hypotheses summary for research model (Source: Authors)

Research Question Two

The second research question was to determine the impact of BIs and FCs on mathematics facilitators' ICT use behavior. **Table 4** shows the influence of:

i. BIs on teachers' ICT use behavior.

ii. FCs on teachers' ICT use behavior.

Table 4 shows enter multiple regression results for the impact of BI, and FC on pre-tertiary mathematics teachers' ICT use behavior. The results from the **Table 4** revealed that BIs (β=.307, p<.000) and FCs (β=.431, p<.000) had a direct positive influence on pre-tertiary mathematics teachers' ICT use Behavior. Additionally, BI and FC explains 46.5% of the variance for predicting teachers' ICT UB. The summary of the quantitative data survey instruments after the enter multiple regression analysis is represented in **Figure 3**.

DISCUSSION

The findings of this study are that the pre-tertiary mathematics teachers purpose of ICT use is to be positively affected by the benefits or PE these teachers get in using ICT for instructional purposes. Among the factors that promote teachers' intention towards ICT, PE was the highest.

An explanation for this is that the majority of the pre-tertiary mathematics teachers sampled for the current study have vast experience in ICT integration (thus, from 11 years and above). This experience enables the teachers to ascertain

the full benefit of ICT usage in mathematics instruction. The present study affirms findings of Raman and Rathakrishnan (2018). In understanding Frog VLE usage among Malaysian teachers, Raman and Rathakrishnan (2018) contended that the teachers' level of acceptance of this technology is crucial for ascertaining whether the investment in the project (1BestraiNet) gives a substantial return. Hence, Raman and Rathakrishnan (2018) adapted UTAUT model to validate the proposed hypotheses of the study. The sample size was 146 teachers with two main statistical packages (SPSS and SmartPLS 3.0) for the data analysis gathered by using the statements or variable constructs developed by (Venkatesh et al., 2003). Similar to findings of this current research, Raman and Rathakrishnan (2018) result revealed that PE (β=.468, p<.010) was the highest deterministic factor for understanding teachers' intentions in using Frog VLM for academic purposes.

Interestingly, the finding from the study depicts that mathematics teachers' intention towards ICT integration in mathematics classrooms is positively impacted by their easiness or less effort expected (EE) in using that particular technology. This means that the less difficult instructional technologies are perceived by teachers' the higher their intentions toward use. EE was recorded from the study as the second highest predicting factor of pre-tertiary mathematics teachers' intentions toward ICT integration in mathematics instruction. This present study's result contradicts the findings of Raman and Rathakrishnan, (2018) who concluded based on the findings of the information collected from 146 teachers in Malaysia about EE on teacher intentions towards Frog VLM use. It concords with other studies (Jehlička & Rejsek, 2018; Khlaif, 2018; Lotey et al., 2023). A similar contradiction was found in the qualitative studies by Saal et al. (2020) using UTAUT model to examine the factors that affect the integration of instructional technology in mathematics in rural areas of South Africa. Graham et al. (2020) findings also contradict the results of this study.

Even though the majority of UTAUT model (e.g., Lewis et al., 2013; Saal et al., 2020) shows that SI had a positive effect on users' intention towards ICT usage, this study revealed a negative but significant effect between SI and teachers' intentions to use ICT for mathematics instruction. This negative SI can discourage individuals from using technology for mathematics instruction. An explanation for the negative effect of SI on BI is that when mathematics teachers perceive a high level of social influence, they may feel pressured. This pressure could lead to a decrease in their intentions to engage in the Behavior. The result from this study is in corroboration with Cimperman et al. (2016) findings. However, a qualitative analysis can be replicated to obtain in-depth knowledge about this negative SI on teachers' intention towards ICT use in mathematics classrooms. The negative SI from the findings of the present study can be attributed to factors such as social pressure, negative social comparison, fear of social isolation, negative social experience, and SI conflict. Birch and Irvine (2009) also concluded from their study that SI did not affect teachers' BI toward ICT use.

FCs such as technical and organizational infrastructures, teachers' ICT training, adequate hardware and software, and compatibility with existing systems were revealed as the strongest factor in predicting pre-tertiary mathematics facilitators' ICT use Behavior in the classroom. The results from this study show that in the absence of FC, pre-tertiary mathematics teachers would be reluctant to adopt ICT for pedagogical purposes in the mathematics classroom. This is because FC in this present study is the higher predictor of pre-tertiary mathematics teacher ICT use Behavior against teachers' intentions. Agyei and Voogt (2011), examined the use of ICT in mathematics instruction at Ghanaian SHSs and identified that FCs like ICT training opportunities, which was lacking among the sampled participants was one of the major hindrances to ICT use in mathematics classrooms. The respondents in this study believe that the more technological tools and gadgets are made readily available together with the necessary conditions (electricity, internet, and technician) the higher their usage in mathematics instruction. The findings are corroborated by other UTAUT studies (Cimperman et al., 2016; Khlaif, 2018).

In the present study, BI was identified to have a positive and statistically significant impact on pre-tertiary mathematics facilitators' ICT use Behavior. This study concords to the findings of Venkatesh et al. (2003). This means that before ICT is used in mathematics instruction, facilitators carefully have a collective plan to adopt ICT tools during the lesson preparation. These plans may be demonstrated through pre-tertiary mathematics facilitators' lesson plans, which can be used to predict facilitators' actual ICT use in instruction. These findings from the study confirm other recent studies (Graham et al., 2020; Mandailina et al., 2019; Saal et al., 2020; Wijaya et al., 2022). In connection to the study of Shah et al. (2021) about teachers' intentions towards ICT use during instruction in Pakistan among 342 valid participants, Shah et al. (2021) results assessed through structural equation modeling (SEM) via AMOS identified BI as a positive and significant factor in predicting UB.

Considering the results from this study, it is vital to disclose that the modified UTAUT model has proved to be a valid conceptual framework for the present study in understating pre-tertiary mathematics facilitators' acceptance and use of ICTs for instructional practices in the Ghanaian educational context. Thus, understanding teachers' use of ICTs for teaching mathematics at both JHS and SHS levels in the country was possible through the lens of UTAUT model adopted for the study.

CONCLUSIONS

The rationale for this study was to use UTAUT model to assess the factors influencing the use of ICT by facilitators in Ghanaian pre-tertiary mathematics education in Kumasi Metro of the Asanti Region. This study provides a careful analysis and a great insight into how pre-tertiary mathematics facilitators adopt ICT for instruction. Based on a quantitative research design, data were gathered via a survey questionnaire from facilitators teaching mathematics at the pre-tertiary levels in the Kumasi Metro of the Asanti Region in Ghana. SPSS was the statistical analysis software deployed for analyzing the data. The analysis was done using descriptive statistics and an enter multiple regression analysis. Results revealed that PE, EE, and SI had a significant impact on pre-tertiary

mathematics facilitators' intention to use ICT in instruction. Even PE and EE had a positive influence on teachers' BIs, SI had a negative influence on intention. Hence, less social pressure must be exerted on teachers to use ICT for academic purposes. BI and FC were positive and significant in predicting mathematics facilitators' adoption of ICTs.

Recommendations

This study provides legion implications in theory and practice. From the findings of the present study, the following recommendation were given, as follows:

1. The Ghanaian government should provide the necessary school infrastructures such as projectors, workshops for ICT professional development or training as well as electricity, which could enrich the use of ICT for mathematics instructions. As the findings of the study revealed that FCs are superior to teacher ICT use Behavior than teachers' intention in using ICT, more government resources must be geared towards enhancing an improved and enriched learning environment that would support teachers' use of technology in the classrooms for better ICT integration.
2. Periodic training in terms of internal workshop could be organized by managerial heads in schools for more knowledgeable peers to educate other teachers on ICT integration. These internal development programs could increase teachers' technological knowledge needed for ICT integration in classrooms.
3. As SI had a negative influence on pre-tertiary mathematics facilitators' intention to integrate ICT in instruction, the researcher argues that heads of schools should modify the way they will socially influence teachers on the use of ICT. This could be done by educating teachers to familiarize themselves with the affordance of ICT and the easiness of ICT in instruction rather than imposing pressure on teachers' ICT adoption for mathematics instructions.

Suggestions for Further Studies

As small sample sizes were used to gather data in both institutions, it is therefore suggested that a larger sample size could be used to enhance the generalization of the findings. A mixed method or qualitative research approach could be adapted as the present study used only a quantitative design. Data generated for the study was obtained from only pre-tertiary mathematics educators in conveniently selected schools, further studies can include school heads and/or students to also examine the teacher's actual ICT use in classrooms. The researcher modified the original UTAUT as proposed by the developers, however, further studies can use the original model to validate the role of the moderators. Also, different variables can be included in further studies in the country.

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