

Full Length Research Paper

Prospective Mathematics teachers' perception about ICT integration in mathematics instruction in Ghana

Wilson, Osafo Apeanti

Department of ICT Education, University of Education, Winneba

E-mail: woapeanti@uew.edu.gh

Accepted 29th August, 2014

This research explored prospective teachers' perceptions of integrating information communication technologies (ICTs) into mathematics instruction and how their perception relates to their willingness to integrate technology. To this end, a survey of 126 prospective teachers in the University of Education Winneba was conducted. The survey provided data concerning their perception of the usefulness of ICT in mathematics instruction, their willingness to integrate ICT tools and their self perceived readiness to integrate ICT in their future instructional practice. The reliability scales (Cronbach's Alpha values) for the survey instrument was 0.726. The analysis of data included descriptive statistics and correlation between prospective teachers' perceived importance of technology and reported levels of willingness to integrate ICT. Results revealed relatively positive perception ($M=3.85$, $SD=0.38$) and willingness to integrate ICT ($M=3.62$, $SD=0.40$). A significant positive correlation ($r = 0.534$, $p = 0.000$) was found between the perception of prospective teachers and their willingness to use ICT in their future instructional practice. The Curriculum Research Development Division (CRDD) of the Ghana Education Service must as a matter of necessity re-examine the mathematics curriculum and revise the existing syllabus to explicitly state what ICT tools must be used and how it should be used in the teaching and learning process. This will enable teachers who have positive perception about the pedagogical usefulness of ICT to take advantage of the provisions made in the curriculum to integrate ICT in their instruction.

Keywords: Prospective teachers' perceptions, information communication technologies, mathematics instruction, Ghana

INTRODUCTION

The impact of information and communication technology (ICT) on teaching and learning has become the focus of many studies intended to improve the quality of education. Until recently, the primary teaching resources available to teachers were the books in libraries. However, ICT has provided a new kind of support for instruction through the development of facilities that supports the teaching and learning process. The adoption of ICT into educational institutions has significantly changed the speed of production, use and distribution of Knowledge. In this regard, the Government of Ghana has placed high emphasis on ICT as a means of improving governance, accountability and transparency for the development of human resource potentials and strengthening national unity through education (Republic of Ghana, 2003, 2005). In 2003 the

Ghana ICT for Accelerated Development (ICT4AD) policy was developed through a nationwide consultation with stakeholders as a plan for the development of Ghana's information society and economy through education. According to the ICT4AD policy, Ghana's educational system is expected to modernise by using ICT to: (i) improve and expand access to educational training and research resources; (ii) improve the quality of education and training and (iii) make the educational system responsive to the needs and requirements of the economy and society with specific reference to the development of the information and knowledge-based economy and society (Republic of Ghana, 2003).

Consistent with the Government goal of implementing ICT in the educational system, in 2007 there was a new educational reform in Ghana which placed high emphas-

is on the integration of

ICT tools in all subject areas. In the pre-tertiary institutions, ICT was made a core subject which every student must pass as a requirement for admission into tertiary institutions. Additionally, the new curriculum emphasized on the use of ICT tools in the teaching and learning process. For instance the new syllabus for mathematics at the Senior High School level encourage teachers to use spreadsheet software in teaching students how to draw graphs, calculate mean, mode, median and standard deviation (Ministry of Education, Science and Sports, 2007).

A number of studies have revealed that integrating ICT in mathematics instruction have the potential to make learning effective and interesting towards improving student learning outcomes by providing opportunities for students to develop skills that will empower them in this modern

society (e.g. Kumar, 2008; Forgasz and Prince, 2004; Fitzallen, 2007; Gill and Dalgarno, 2008). The standards of the National Council of Teachers of Mathematics (NCTM) stresses that, technology can facilitate mathematical problem solving, communication, reasoning, and proof; moreover, technology can provide students with opportunities to explore different representations of mathematical ideas and support them in making connections both within and outside of mathematics (NCTM, 2000). Students can use technology to explore and reach an understanding of mathematical concepts because technology allows students to focus on strategies and interpretations of answers rather than spend time on tedious computational calculations (Keong, Horan and Danie, 2005; UNESCO, 2005).

Regardless of the apparent advantages of ICT integration in mathematics instruction which has been confirmed by many studies (eg. NCTM, 2000; Forgasz and Prince, 2004; UNESCO, 2005; Kumar, 2008), the deployment and use of ICT in Ghanaian school contexts remains problematic. The common explanation for the lack of ICT integration in the instructional process is the varying levels of resistance by teachers to use ICT tools. Olson (2000), for instance indicated that teachers labels ICT as a 'Trojan Horse' and asks why they should abandon the safety and comfort of recognised subject pedagogy for the uncertainties and complexities that surround the use of ICT. Obviously, teachers' perception about ICT integration plays a significant role in their use or nonuse of ICT in the instructional process. An earlier study by Grabe and Grabe (1998) reported a situation in which computers were not used effectively in teaching practice, due in part to teachers' perception and fears regarding relatively new technologies. Thus, without knowledge of teachers' and prospective teachers' perceptions and future plans for using ICT in education, any potential innovations in this area may be deficient (Can and Cagiltay, 2006).

Statement of the problem

There has been significant effort by government of Ghana in the introduction of ICT in teacher education in terms of curriculum and infrastructure at the Colleges of Education and University level (Ministry of Education, 2009). The goal is to train technologically competent graduate teachers who will be able to integrate ICT in their future instructional practice. However, even though 87% of second cycle institutions in Ghana are well equipped with ICT facilities (Ministry of Education, 2009) statistics indicate that majority of trained mathematics teachers in Ghana are not integrating ICT in their instruction (MOE, 2009; Mereku et al, 2009). Even though there appears to be no single factor that determines why mathematics teachers are not using ICT in their teaching, there is widespread agreement that their perception plays a significant role (Lai, Pratt, and Trewern, 2001; Can and Cagiltay, 2006)

The relationship between teachers' ICT skills and successful implementation is complex because, there are a range of contributing issues including teacher perception and intention in addition to having the necessary skills, equipment, support, and education (Granger, Morbey, Owston and Wideman, 2002). Consequently, in spite of the increasing levels of teachers knowledge in ICT over the years and the obvious benefits of ICT integration in mathematics instruction, studies have continually shown that, many mathematics teachers who are ICT literate do not integrate ICT tools in their teaching (e.g. So and Swatman, 2006 ; Lua and Sim, 2008).

Studies on teachers' readiness for ICT integration generally suggest that there is still a long way to go before schools will be able to take full advantage of the opportunities provided by 21st century technology (e.g. So and Swatman, 2006). Barak (2006) reveals that teachers exploit ICT for their own learning but they are cautious about integrating advanced technologies in their instruction. According to Barak, while teachers recognize the potential of technology in stimulating students' learning and making school studies relevant to real-life contexts, they do not think that ICT is preferable for class-based instruction or for promoting cooperation and reflection in learning. Clearly, the perception of teachers especially prospective teachers are critical to the success or failure of ICT integrating in the teaching and learning process (Can and Cagiltay, 2006). Teachers tend to use technology in ways shaped by their own personal perspectives on the curriculum and on their pedagogical practices (Lai, Pratt, and Trewern, 2001). Therefore it would be unwise to suggest integrating ICT into classrooms before more fully investigating teachers' (particularly prospective teachers) perceptions about ICT integration.

Purpose

The purpose of this study was to investigate prospective teachers' perception about ICT integration and their future plans for using ICT in their teaching. The focus of this study on prospective teachers' perceptions is significant, because in order to estimate the possibility of change regarding the use of computers in classroom instruction, it is very important to understand the current perceptions of future teachers who are expected to be the agent of change in relation to ICT integration.

This study specifically investigated:

- The perceptions of prospective mathematics teachers regarding the use of ICT in the teaching and learning process
- Prospective mathematics teachers' future plans for using of ICT in the teaching and learning environment that they will design in future.

Literature

Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB)

Older studies have indicated that adequate knowledge and skills in the pedagogical use of ICT is a necessary but not always sufficient condition for the integration of ICT in teaching and learning process (e.g. Mathieson, 1991). Therefore, as well as looking at the knowledge and skills of teachers in ICT integration and other aspects of the formal teacher preparation, the prospective teachers' personal preparedness including their perception of the usefulness of ICT and confidence, along with various social factors are important (Gill and Dalgarno, 2008). Dominant theoretical models for determining the intention and readiness of prospective teachers to use technology in their future instructional practice includes the Technology Acceptance

Model (TAM) (Davis, 1989) and the Theory of Planned Behaviour (TPB) (Ajzen, 1985, 1991). The Technology Acceptance Model (TAM) is perhaps the most widely applied theoretical model in technology use research. TAM was developed by Davis (1989) to explain computer-usage behaviour. The goal of TAM was to provide an explanation of the determinants of computer acceptance that is in general, capable of explaining user behaviour across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified (Davis, 1989). TAM specifies the causal linkages between two key sets of constructs: (1) Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), and (2) user's attitude (A), behavioural intentions (BI) and actual computer usage behaviour (Figure 1).

PU is defined as the user's subjective probability that using a specific technology will increase his or her

performance within an organizational context while PEOU refers to the degree to which the user expects the target technology to be free of effort (Davis, 1989).

Both Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) predict attitude toward using technology and is also defined as the user's interest in the use of the technology. Attitude

(A) and Perceived Usefulness (PU) influence the individual's Behavioural Intention (BI) to use the system. The actual use of the system is predicted by BI (see figure 1). A review of scholarly research on technology acceptance and usage suggests that TAM has emerged as one of the most influential models in the stream of recent research (e.g. Chi, Hong, and Toe, 2008; Jong and Wang, 2009). The TAM represents an important theoretical contribution toward understanding the use of ICT by teachers and ICT acceptance behaviour. However, the TAM with its original emphasis on the design of system characteristics does not account for social influence in the adoption and utilization of new information systems (Davis, 1989).

According to the Theory of Planned Behaviour (TPB) (Ajzen, 1985, 1991), behaviour is

determined by intention (I) to perform the behaviour. Intention is predicted by three factors: Attitude toward the behaviour (A), Subjective Norms (SN), and Perceived Behavioural Control (PBC) (see Figure 2).

Both Attitude (A) and Intention (I) have the same meaning as for TAM model. Subjective Norm (SN) is the individual's perception of social pressure to perform the behaviour. Perceived Behaviour Control (PBC) is the individual's perception of his or her control over performance of the behaviour. Beliefs are antecedent to attitude, subjective norms, and perceived behavioural control. Attitude is a function of the products of behavioural beliefs and outcome evaluations. A behavioural belief is the subjective probability that the behaviour will lead to a particular outcome. According to the TPB model, to predict whether a person intends to do something, we need

to know;

- (i) whether the person is in favor of doing it ('attitude')
- (ii) how much the person feels social pressure to do it ('subjective norm') and
- (iii) whether the person feels in control of the action in question ('perceived behavioural control').

By changing these three 'predictors', we can increase the chance that the person will intend to do a desired action and thus increase the chance of the person actually doing it.

TAM and TPB were used in this study as the baseline models to investigate prospective teachers' perceptions of the usefulness (PU in the TAM model and SN in the TPB model) of ICT in mathematics instruction and the relationship it has on their readiness to use ICT in their future instruction (Actual use in TAM and Behaviour in TPB).

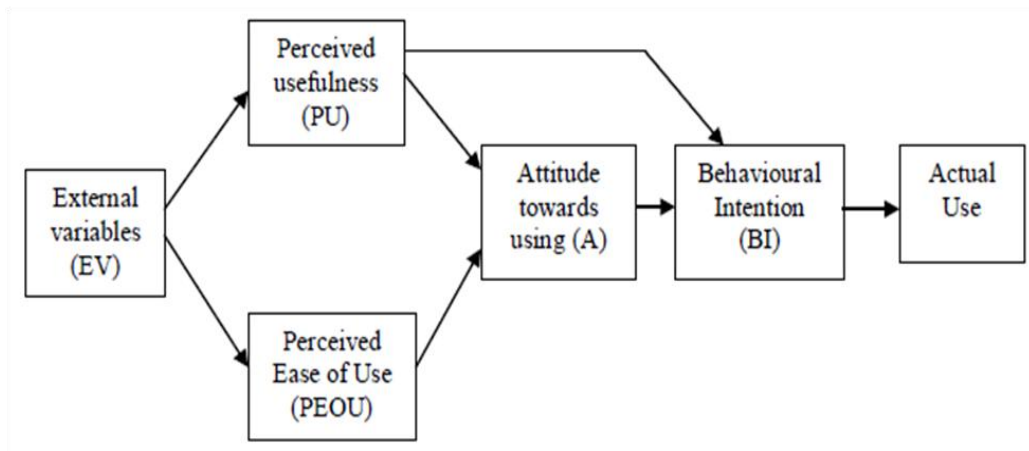


Figure 1: Technology Acceptance Model (TAM)

Source: Davis (1989)

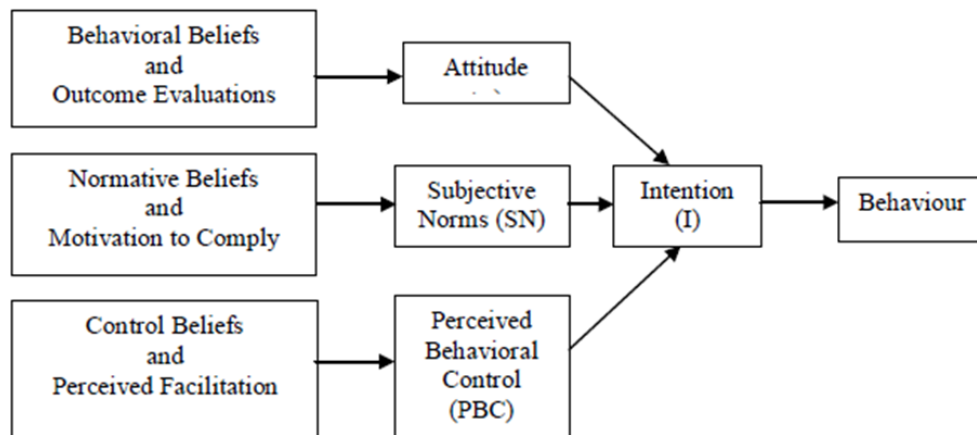


Figure 2. The Theory of Planned Behaviour

Source: Ajzen (1991)

Prospective Teachers' Perception of ICT integration in instruction

Teachers' perceptions are critical to the success or failure of ICT integration in mathematics instruction. As a result, it is essential to gather information about the concerns they might have with regard to using ICT tools in classroom instruction. Lua and Sim (2008) investigated the perception of two hundred and fifty (250) secondary schools teachers of Mathematics and Science in Malaysia. It was found that, in general, teachers broadly agree that use of ICTs makes them more effective in their teaching (75%), more organized in their work (80%) and better able to meet the varying needs of students (48%). Teachers broadly agreed that with the use of internet and technology in their lesson plans are richer (55%). A further positive sign was that, 85% of them indicated that they would like to integrate more computer applications into their teaching. It

appears that teachers' perceptions toward ICTs are encouraging, where most of them showed positive perceptions on computer use in teaching and instruction. It is believed that teachers can see the value of the ICTs in enhancing teaching and learning, and they are positive towards further integration of technologies into classroom instruction.

Can and Cagiltay (2006) conducted a study to investigate the perceptions and future plans of a group of prospective computer teachers in Turkey. The study revealed that participants have positive perceptions regarding the use of computer games with educational features in education. However, some of the participants have doubts, especially concerning the issues of classroom management and the educational effectiveness of new computer games currently on the market. This may be due to the perception of the participants about the adoption of new technologies other than the ones they are familiar with. Consequently, these teachers might be reluctant to use new computer

games and technology in their future instructional practice. This is in line with Woodrow (1992) assertion that any successful transformation in educational practice requires the development of positive user perceptions and attitudes toward new technologies. Therefore, the development of teachers' positive perception and attitudes toward ICT is a key factor not only for enhancing computer integration but also for avoiding teachers' resistance to use new computer technologies that they are not familiar with

Other studies that have investigated the factors hindering teachers' readiness and confidence in using ICTs have found that inadequate knowledge and skills to evaluate the role of ICT in teaching and learning, lack of skills in the use of ICT equipment and software had resulted in a lack of confidence in utilizing ICT tools (Preston, Ox, and Cox, 2000; Tella, et al., 2007). Additionally, some studies have also indicated that, recurring faults, and the expectation of faults occurring during teaching sessions reduces teachers' confidence and cause teachers to avoid using technology (Bradley and Russell, 1997; Slaouti and Barton, 2007).

While there is a great deal of studies about how ICT is being used in developed countries, there is not much information on how ICT is being integrated into schools in developing countries (Beukes-Amis and Chiware, 2006). Earlier studies have indicated that even though there are computer technology resources available in many schools in developing countries such as Ghana, teachers are not willing to adopt them in the teaching and learning process as much as is expected (e.g. Dusick, 1998). As a result, questions have been raised about the perception of teacher on the use of ICT in the instructional process. However, various studies have indicated that, most of the perception that teachers hold are rooted in the way that they trained for the integration of technology in their professional practice (e.g. Niess, 2006).

METHODOLOGY

Design

This study was designed as a survey research study. Its main purpose was to investigate and describe the perceptions of prospective mathematics teachers concerning the use ICT in their features instructional practice. Both qualitative and quantitative data were collected through a survey instruments with both closed and open ended items.

Participants

One hundred and twenty six (126) third year undergraduate students from the Department of

Mathematics Education in the University of Education, Winneba (UEW) which is the largest public university mandated to train teachers in Ghana. The aim of this department is to equip prospective mathematics teachers with knowledge in the use of instructional technology in mathematics education. Graduates are expected to be able to integrate a variety of technology into their teaching. In view of this, the department in 2003/2004 academic year introduced cognate ICT courses to the mathematics curriculum in order to equip students with ICT tools for teaching and learning mathematics. The Department has set up departmental computer laboratory which is equipped with 50 computers and a digital projector for the purpose of training students in ICT.

Sampling Technique

Purposive sampling technique was used to select participants. The choice of the third year students as the sample for the study was based on the fact that the third year prospective mathematics teachers would have studied enough content in both mathematics and ICT courses as at the time of administering the instrument. Furthermore, Mathematics Education undergraduate students in the UEW are required to go on an out segment program to teach mathematics in various non-tertiary intuitions in their final year (fourth year) which made it imperative to investigate their perception about ICT integration in mathematics instruction.

Instrument

Teachers' perception about ICT integration questionnaire which was adapted and modified from Yidana (2007) was used to provide data on the teachers' perceptions about ICT integration. The questionnaire has three parts, with a total of twenty two (22) items. The first part contained fifteen (1-15) items that investigated the participants' perceptions regarding the use of ICT in mathematics instruction. The second part consisted of five (16-20) Items that was used to investigate participants' wiliness to use ICT in their future instructional practice. Part one and two of the questionnaire consisted of a five –point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree) items. A five-point scale was preferred over a four-point scale because of the high number of missing responses in the pilot study. The third part of the instrument was an open ended question that gave participants the chance to express their general views about the integration of ICT in mathematics instruction as future teachers. The last item on the questionnaire item (22) allowed respondents to indicate their level of readiness to use ICT tools in their future instruction. The reliability scales (Cronbach's Alpha values) for the

instrument was .726 which indicates a high degree of reliability of the items in the instrument (Fraenkel and Wallem, 2000).

Data collection procedure

Data were collected from 126 students in a three-day period, during the students' regular course hours at the beginning of a class. The questionnaire was administered with permission from the course instructor and students. The response rates were 100%. On average, the students completed the questionnaires in 15 minutes. The purpose of the research and the directions for answering the questionnaires were clearly written on the questionnaire and participants were required to read them before answering them. The researcher was present throughout the administration of the questionnaire, to answer any problems or questions from respondents.

Data analysis procedure

The data analysis procedure blended both descriptive statistical data analysis and the qualitative data analysis. With regards to the descriptive data, SPSS software was used for the data input, and for calculation of frequencies and percentages. The qualitative data was discussed along with the finding of the descriptive statistics.

FINDINGS

The perceptions of prospective mathematics teachers regarding the use of ICT in the teaching and learning process

Table 1 indicates prospective mathematics teachers' ratings on the effectiveness of ICT integration in mathematics instruction. Majority of the participants (88%, $n = 110$) agreed or strongly agreed with item 1 which indicates that a large number of the participants agreed that students are enthusiastic about the subject for which they use computers as one of the participant indicated " *integration of ICT in teaching will elicit student interest in mathematics concepts.*" For item 2, 72.3% ($n = 71$) out of 124 participants agreed or strongly agreed that ICT is an effective tool for students of all abilities. This was corroborated by one of the participant who asserted that: "*ICT and mathematics are a better pair that can help improve the technical abilities of individual students.*"

Also, since item 3 was negatively coded, the 41.2% ($n = 64$) who disagreed or strongly disagreed, it implied that 59.8% of the participants established that ICT integration increase their personal interaction with students.

Cumulatively 77.6% ($n=97$) agreed or strongly agreed with item 4 which signifies that a large percentage of the respondents perceived that the use of ICT will help them meet individual students' needs.

Significantly large number ($n=113$ (90.4%)) of respondents agreed or strongly agreed that computer provides an environment that appeal to variety of learning styles (Item 5) as one of the participants indicated:

Integrating ICT in teaching and learning of mathematics is laudable as a future mathematics teacher. It helps to reduce the monotonous nature of teaching and learning and brings a variety of teaching and learning processes.

Additionally, 92% ($n=115$) of the participants agreed or strongly agreed that the internet is an effective means of expanding what have been taught in class (Item 6) as one of the participants indicated: *The integration of ICT in mathematics will go a long way to affect the subject positively even though there may be some lapses. It will help students to have an in-depth understanding of every topic as the internet at their disposal to research more.*

Furthermore, 89.7% ($n=112$) out of 124 participants agreed or strongly agreed with item 7 which shows that most of the participants perceived that, ICT integration will help them facilitate students learning.

For Item 8, 86.4% ($n=108$) of the participants agreed or strongly agreed which indicates that, most of the participants perceived that ICT integration enhances students cooperation. This was indicated by one of the participant that: "*the integration of ICT in the teaching and learning of mathematics will help students to be abreast with computer, it will arouse their cooperation in their study in class*". Item 9 was negatively coded therefore, the 48% ($n=60$) of the respondents who disagreed or strongly disagreed shows that less than half to the respondent perceived that

ICT enhances students learning ability in mathematics instruction. For item 10, 68% ($n=85$) of the participants agreed or strongly agreed which shows that slightly more than half of the participants perceived that e-mail is an effective way of disseminating course materials.

Out of 125 participants, 71.3% ($n=89$) agreed or strongly agreed that the use of web-based instruction will make students feel more involve in the mathematics lesson. Nevertheless, only 52% ($n=65$) disagreed or strongly disagreed that the use of web-based technology reduces personal interaction with students. This shows that even though a large percentage of participants perceived that the use of web based technology will involve students in the lesson only a small percentage of them think that web-based technology will help them interact with students. For item 43, 72.8% ($n=91$) out of 125 participants agreed or strongly agreed, which indicates that most of the participants perceived computer tools will enable them interact with their students.

Table 1: Prospective mathematics teachers' perception of the effectiveness of ICT integration

Item	SD n (%)	D n(%)	N n (%)	A n (%)	SA n(%)	N
1. Students are more enthusiastic about the subjects for which they use computers.	1(.8)	4(3.2)	10(8)	53(42.4)	57(45.6)	125*
2. The use of instructional technology is an effective tool for students of all abilities.	4(3.2)	10(8.1)	19(15.3)	37(29.8)	54(43.5)	124*
3. The use of computer-based technology in instruction reduces my personal interaction with my students.	19(15.2)	45(36)	15(12)	35(28)	11(8.8)	125*
4. When using technology, I will be able to tailor students' work to their individual needs.	2(1.5)	4(3.2)	22(17.6)	72(57.6)	25(20)	125*
5. Computers provide environments that appeal to a variety of learning styles of my students.	0(0)	1(.8)	11(8.8)	74(59.2)	39(31.2)	125*
6. The Internet provides a means of expanding and applying what has been taught in class.	0(0)	1(.8)	9(7.2)	51(40.8)	64(51.2)	125*
7. When using technology, my role will be as a facilitator of individual students' learning.	1(.8)	3(2.4)	9(7.3)	58(46.8)	53(42.7)	124*
8. Technology tools will enable students to cooperate more on projects.	2(1.5)	7(5.6)	8(5.4)	60(48)	48(38.4)	125*
9. Computers hinder students' ability with learning tasks (e.g., writing, analyzing data, or solving problems).	32(25.6)	28(22.4)	21(16.8)	18(14.4)	26(20.8)	125*
10. E-mail is an effective means of disseminating course material to students.	5(4)	17(13.6)	18(14.4)	33(26.4)	52(41.6)	125*
11. The use of web-based instruction would make the student feel more involved.	4(3.2)	8(6.4)	24(19.2)	61(48.8)	28(22.4)	125*
12. The use of web-based technology almost always reduces the personal treatment of students.	17(13.6)	48(38.4)	31(24.8)	23(18.4)	6(4.8)	125*
13. Computer tools would enable me to interact more with students.	4(3.2)	10(8.0)	20(16.0)	49(39.2)	42(33.6)	125*
14. I believe by integrating technology in teaching and learning, I am helping students to acquire the basic computer education needed for their future careers.	1(.8)	2(1.6)	5(4.0)	52(41.9)	64(51.6)	124*
15. I feel the use of technology for instruction would affect my students' positively	6(4.8)	9(7.2)	8(6.4)	60(48.0)	42(33.6)	125*

* The total was less due to missing responses.

Notably, a significantly high number (n=116, 93.4%) of the participants agreed or strongly agreed that they believe integrating technology will help their students acquire basic computer skills (Item 14). This was indicated by one of the participants who asserted that *"as a mathematics teacher I will use instructional technology tools more often to help students to acquire the basic computer education needed for their future careers."* Also 82.6% (n=102) of the respondents perceived that the use of ICT will affect students learning and their teaching method in a positive way as one of the participants indicated: *"ICT integration will enhance the teaching and learning of mathematics as the students are actively involved in the teaching and learning process. It will also enhance students'*

manipulative skills as well as analytical and critical thinking skills."

The overall mean score of prospective teachers perception about the effectiveness of ICT integration in mathematics instruction was 3.85 (SD = 0.380) which shows that the participants of the study have a positive perception about the effectiveness of ICT integration in mathematics instruction.

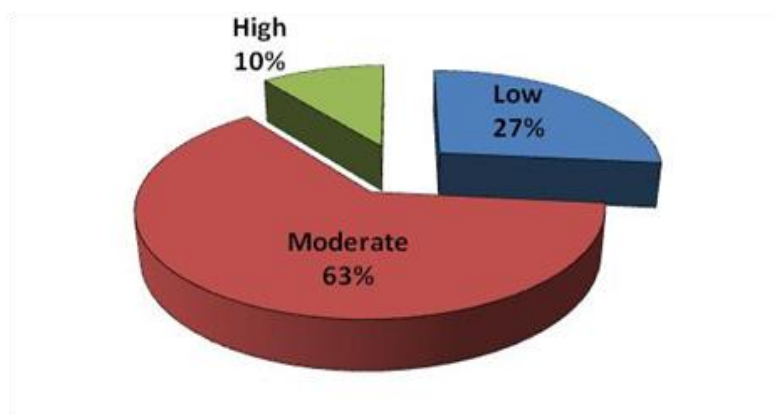
Prospective mathematics willingness to use integrate ICT in teaching and learning

Table 2 below indicates prospective teachers' willingness to use instructional technology in their future teaching.

Table 2: Prospective teachers' wiliness to use technology in their future instruction

Item	SD N(%)	D N(%)	N N(%)	A N(%)	SA N(%)	N
16. I will use instructional technology tools more often, if they were available in my classroom.	0(0)	1(0.8)	4(3.2)	62(49.2)	59(46.8)	126
17. I will use subject/curricular-based software in my instruction.	3(2.4)	0(0)	9(7.1)	74(62.7)	35(27.8)	121*
18. I will perform Internet searches for my classroom instruction.	1(0.8)	1(0.8)	11(8.7)	68(54.0)	45(35.7)	126
19. I will use basic computer applications (e.g., word processing, spreadsheets and PowerPoint) for instruction.	0(0)	0(0)	10(7.9)	63(50)	53(42.1)	126
20. If I get the opportunity, I will use audio and video web-based systems for instruction.	0(0)	3(2.4)	8(6.3)	68(54.0)	46(36.5)	125*

* The total was less due to missing responses

**Figure 3:** Prospective teachers perceived level of readiness for ICT integration

Significant number of the participants (n= 121 (96%)) agreed or strongly agreed that they will use instructional technology more often if they were available. This trend was found in the other items. The participants agreed or strongly agreed that they will use subject based software (n=109(90.5%)), perform internet searches (n=113 (89%)), use basic application software (n=116 (92.1%)) and web-based audio visual systems (n=114(90.5%) for instruction.

Questionnaire item 22 was used to find out prospective teachers perceived level of readiness to integrate ICT. The levels were grouped under three categories:

- i. Low- the ability to perform basic functions in the computing, but will still require help on a regular basis
- ii. Moderate - competence in a number of computer applications for instruction
- iii. High- proficiency in using a wide variety of computer technologies for instruction

The result indicated that, out of the 124 participants who responded to this items, 27% (n=13) have a low level of

readiness to use ICT for instruction, 63% (n=78) have a moderate level of readiness to use ICT for instruction and 10% (n=13) have a high level of readiness to use ICT for instruction (Figure 3).

This shows that few (10%) participants perceived that they are highly prepared for ICT integration, while majority (63%) of them indicated that they were moderately prepared for ICT integration.

Relationship between prospective teachers' perception and their wiliness to integrate ICT

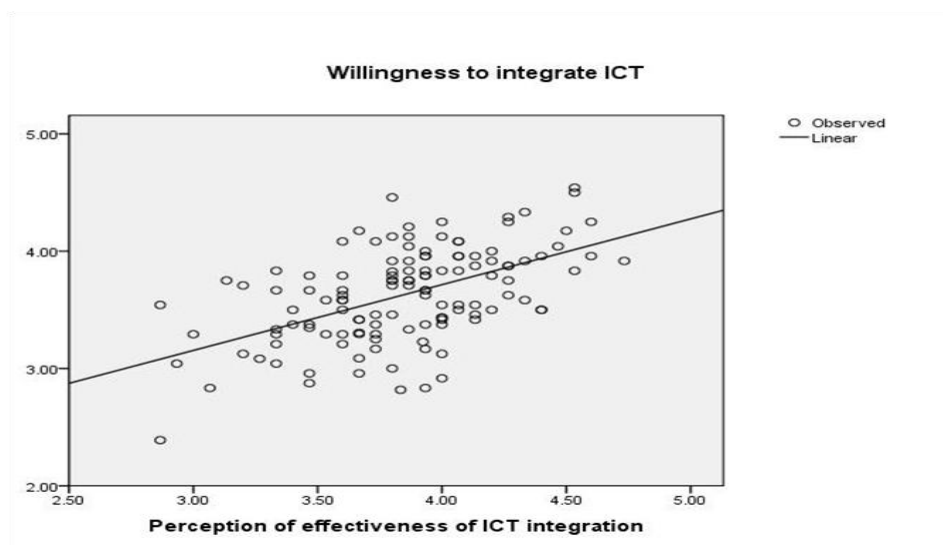
The relationship between prospective teachers' perception and their wiliness to use ICT in their instruction was investigated using Pearson correlation. A significant positive correlation ($r = 0.534$, $p = 0.000$) was found between the perception of prospective teachers and their wiliness to use ICT in their future instructional practice (Table 3)

The scatter plot below (figure 4) shows the positive

Table 3. Relationship between prospective teachers' perception and willingness to integrate ICT

Factor	N	Mean	Std. Deviation	r	P-value
Willingness to integrate ICT	126	3.62	0.40	0.534	0.000*
Perception of effectiveness of ICT integration	126	3.85	0.38		

* Correlation is significant at 0.05 level

**Figure 4:** Scatter plot of perception of effectiveness of ICT and willingness to integrate ICT

linear correlation between prospective teachers' perception of the effectiveness of ICT and their willingness to use ICT in their future instruction. This finding indicates that, prospective teachers with positive perception about the effectiveness of ICT integration will be more willing to use ICT in their future instruction than those with negative perception.

DISCUSSIONS

The findings of this study suggest that prospective mathematics teachers support the view that the integration of ICT is pedagogically useful in:

- i. Promoting Students' enthusiasm about mathematics
- ii. Providing suitable learning environments that appeal to a variety of learning styles of students
- iii. Helping students to acquire the basic computer education needed for their future careers.
- iv. Promoting cooperative work among students
- v. Helping students to expand and applying what has been taught in class.

These findings are consistent with the results of other

similar studies carried out in different countries with teachers and educators by Can and Cagiltay (2006); Lua and Sim (2008) which revealed that, in general, teachers broadly have positive perceptions about the use of ICT in the teaching and learning process. Particularly, Lua and Sim (2008) found that, in general teachers broadly agree that the use of ICT:

- (i) make them more effective and organize in their teaching,
- (ii) help them to meet the varying needs of students,
- (iii) make their lesson plan richer with the use of the internet.

Finley and Hartman (2004) found out that teachers would experiment with technology integration if (i) they feel it is consistent with their teaching style, (ii) they feel they are knowledgeable and competently skilled, (iii) they are supported and rewarded for doing so, and (iv) they can see how it is pedagogically useful. Consequently, the prospective teachers' positive perception about the pedagogical usefulness of ICT is a key factor in reducing their resistance to use new computer technologies that they are not familiar with in their future instructional practices.

It was also found in this study that, prospective teachers' perception had a significant positive correlation with their willingness to integrate ICT. This finding is common in the literature (e.g. Ertmer, 2005; Windschitl and Sahl, 2002; Zhao et al., 2002). Studies have continuously shown that, if teachers have negative perceptions of integrating ICTs into instruction, they are not likely to achieve a more authentic curricular integration of ICT. The decision regarding whether and how to use technology for instruction rests on the shoulders of classroom teachers. If educators are to achieve fundamental changes in classroom teaching practices there is a need to examine teachers themselves and the perceptions they hold about teaching and learning with technology (Ertmer, 2005).

An earlier study by Woodrow (1992) asserted that any successful transformation in educational practice requires the development of positive user perceptions toward the use of new technologies in the teaching and learning process. Consequently, there is a need to encourage

prospective teachers to move belief into practice so that their positive perceptions about the usefulness of ICTs in the teaching and learning process will reflect in our schools. Palak (2004) observed that, instructional technology practices of teachers are substantially related to the contextual conditions in their teaching environments. Therefore, despite the generally positive perception of prospective teachers about ICT integration, contextual conditions might affect the effective implementation of technology integration in mathematics instruction in Ghana.

RECOMMENDATION

It was also found in the study that prospective mathematics teachers generally have positive perception about the pedagogical usefulness of ICT in the teaching and learning process. Furthermore, their perception correlates significantly with the willingness to integrate ICT. Therefore it is recommended that:

a. The Curriculum Research Development Division (CRDD) of the Ghana Education Service must as a matter of necessity re-examine the mathematics curriculum and revise the existing syllabus to explicitly state what ICT tools must be used and how it should be used in the teaching and learning process. This will enable teachers who have positive perception about the pedagogical usefulness of ICT to take advantage of the provisions made in the curriculum to integrate ICT in their instruction.

b. The Ministry of Education should set standards for the recruitment of new mathematics teacher and these standards should include practical knowledge in the use of ICT tools for teaching and learning so that Colleges of Education and teacher training Universities will take the necessary steps to train their student in ICT integration.

REFERENCES

- Ajzen I (1991). The theory of planned behavior. *Organizational Behaviour and Human Decision Processes*, 50, 179-211.
- Ajzen I (1985). From intentions to actions: A theory of planned behaviour. In J Kuhl, J Beckman (Eds), *Action control: From cognition to behavior*. New York: Springer.
- Barak M (2006). Instructional principles for fostering learning with ICT: teachers' perspectives as learners and instructors. *Education Information Technology*, 11:121-135.
- Beukes-Amis CM, Chiware ERT (2006). The impact of diffusion of ICTs into educational practices, how good or how bad? A review of the Namibia situation. Retrieved May 12, 2009 from [http://www.dspace.unam.na:8443/dspace/bitstream/1995/244/impact+diffusionIC Tedu. Pdf](http://www.dspace.unam.na:8443/dspace/bitstream/1995/244/impact+diffusionIC%20Tedu.Pdf)
- Can G, Cagiltay K (2006). Turkish Prospective Teachers' Perceptions Regarding the Use of Computer Games with Educational Features. *Educational Technology and Society*, 9 (1):308-321.
- Chi CS, Hong HY, Toe T (2008). Singaporean and Taiwanese pre-service teachers' beliefs and their attitude towards ICT: A comparative study. Retrieve 24 October, 2009 from <http://www.apsce.net/icce2008/papers/ICCE2008-paper19.pdf>
- Davis, F.D. (1989) Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 13, 319-340.
- Dusick, D. M. (1998). What social cognitive factors influence faculty members' use of computers for teaching? A literature review. *Journal of Research on Computing in Education*, 31(2), 123.
- Ertmer, P. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration. *Educational Technology Research and Development*, 53(4), 25 – 39
- Fitzallen N (2007). Integrating ICT into Professional Practice: A Case Study of Four Mathematics Teachers. Retrieved March 5, 2009, from <http://www.merga.net.au/documents/RP372005.pdf>
- Forgasz H, Prince N (2004). Computers for secondary mathematics: Who uses them and how? Retrieved March 2, 2009, from <http://aare.edu.au/01pap/for01109.htm>
- Fraenkel JR, Wallen NE (2003). *How to design and evaluate research in education*, (5th ed.). New York: McGraw-Hill Publishing Co.
- Gill L, Dalgarno B (2008). Influences on pre-service teachers' preparedness to use ICTs in the classroom. Retrieved May 2, 2009, from <http://www.aare.edu.au/03pap/war03165.pdf>
- Gill L, Dalgarno B (2008). Influences on pre-service teachers' preparedness to use ICTs in the classroom. Retrieved May 2, 2009, from <http://www.aare.edu.au/03pap/war03165.pdf>
- Goodson IF, Mangen JF (1995). Subject cultures and the introduction of classroom computers, *British Educational Research Journal*, 21(5), 613–629.
- Grabe M, Grabe C (1998). *Integrating Technology for Meaningful Learning* (2nd Ed.), Boston, USA: Houghton Mifflin Company.
- Granger C, Morbey H, Owston R, Wideman H (2002). Factors contributing to teachers' successful implementation of IT. *Journal of Computer Assisted Learning*, 18, 480-488.
- Jong D, Wong TS (2009). Students acceptance of web based systems. *Proceedings of the 2009 International Symposium on Web Information Systems and Applications (WISA'09)*.

- Nanchang, China, (pp.533-536.) Retrieved 23 October, 2009 from <http://www.academypublisher.com/proc/wisa09/papers/wisa09p533.pdf>
- Keong CC, Horan IS, Danie IJ (2005). A study on the use of ICT in mathematics teaching. Malaysian Online Journal of Instructional Technology (MOJIT) 2 (3), 43-51 Retrieved June 12, 2010, from <http://www.unesco.org/education/pdf/singh.pdf>
- Kumar R (2008). Convergence of ICT and Education. Proceedings of world academy of science, engineering and technology (pp. 556-559). Ghaziabad, India: WASET.ORG
- Lai KW, Pratt K, Trewern A (2001). Learning with technology: evaluation of the Otago secondary schools technology project. Dunedin: The Community Trust of Otago
- Lau BT, Sim CH (2008). Exploring the extent of ICT adoption among secondary school teachers in Malaysia. Retrieved 23 October, 2009 from <http://www.ijcir.org/volume2number2/article3%2019-36.pdf>.
- Mathieson K (1991). Predicting User Intentions: Comparing the Technology Acceptance Model with the Theory of Planned Behavior. Retrieved 23 October 2009 from <http://management.uta.edu/Casper/6314/multiple%20regression%20by%20students/medation%20regression-sandy.pdf>
- Mereku DK, Yidana I, Hodzi W, Tete-Mensah I, Tete-Mensah W, Williams JB (2009). Pan-African research agenda on the pedagogical integration of ICT: Phase 1 Ghana report. University of Education, Winneba, Canada: International Development Research Center (IDRC)
- Ministry of Education, Science and Sports. (2007). Teaching syllabus for mathematics (Senior High School). Accra: Curriculum Research and Development Division (CRDD).
- Ministry of Education. (2009). Report on e-readiness assessment of second cycle institutions in Ghana. Accra: ICT in Education Programmes Unit, Ministry of Education.
- National Council of Teachers of Mathematics. (2000). Principles and standards for school mathematics. Reston, VA: NCTM
- Neiss ML (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. Teaching and Teacher Education, 21(5), 509–523.
- Olson J (2000) Trojan horse or teacher's pet? Computers and the culture of schools, Journal of Curriculum Studies, 32(1), 1–9.
- Republic of Ghana. (2003). The Ghana ICT for accelerated development (ICT4AD) policy. Accra, Ghana: Graphic Communications Group Limited.
- Republic of Ghana. (2005). Growth and poverty reduction strategy (GPRS II) (2006-2009). Retrieved May 5, 2009, from <http://www.imf.org/external/pubs/ft/scr/2006/cr06225.pdf>
- Selwyn N (1999). Differences in educational computer use: the influence of subject cultures, The Curriculum J., 12(1):11–29.
- So T, Swatman PMC (2006). e-Learning Readiness of Hong Kong Teachers. University of South Australia.
- UNESCO (2005). Regional guidelines on teacher development for pedagogical integration [Working draft]. Bangkok, Thailand.
- Windschitl M, Sahl K (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics, and institutional culture. American Educational Research Journal, 39(1), 165- 205.
- Zhao Y, Cziko GA (2001) Teacher adoption of technology: a perceptual control theory perspective, Journal of Technology and Teacher Education, 9(1), 5–30.
- Zhao Y, Pugh K, Sheldon S, Byers J (2002). Conditions for classroom technology innovations. Teachers College Record, 104 (3), 482– 515