

**PRE-SERVICE TEACHERS' PERCEPTION OF THE USE OF INFORMATION
COMMUNICATION AND TECHNOLOGY (ICT) IN THE TEACHING AND
LEARNING OF MATHEMATICS IN THREE COLLEGES OF EDUCATION IN
GHANA**

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ABSTRACT: *The study sought to explore pre-service teachers' perception about the use of ICT in the teaching and learning of Mathematics. Two hundred and forty two (242) level 200 teacher trainees offering the special Science and Mathematics programmes at Akatsi College of Education and St. Francis College of Education in the Volta region and OLA College of Education in the Central region of Ghana were conveniently sampled for the study. A questionnaire divided into three thematic areas namely perceived barriers in the use of ICT, current pedagogical practices and professional development and training needs of tutors was used to collect data. The study found that the use of ICT could help facilitate the teaching and learning of Mathematics. The study also revealed the inability of college tutors to integrate ICT into the teaching and learning of Mathematics. It was concluded that college tutors need special ICT training courses to be able to effectively use ICT to facilitate the teaching and learning of Mathematics. Consequently the study recommended among others that the National Council for Tertiary Education in close collaboration with the Ministry of Education and other stake holders of Education should organize special ICT training courses for college tutors in the field from time to time to equip them with those special skills and knowledge needed to enable them integrate ICT into the teaching and learning of Mathematics in order to facilitate the processes.*

KEYWORD: Information and Communication Technology, Mathematics, Teaching and Learning

INTRODUCTION

Technology integration in the classroom has become an important aspect of successful teaching and learning. Therefore, the integration of Information and Communication Technology (ICT) into education remains a crucial issue for teachers to teach effectively. ICT integration in teacher education and teaching practices of teachers is a complex and challenging issue. In this regard, Gülbahar (2008) identified that just equipping schools with the essential ICT tools does not improve the quality of instruction and does not create more effective learning environments. As a result, the Government of Ghana made various attempts in the past to improve the achievement in mathematics in schools carried out reforms with the curriculum, placing a lot of emphasis on ICT as a tool for teaching mathematics (MOESS 2007).

As one of the Sub-Saharan African countries with a national policy and implementation plan for technology in education (Tilya, 2008), Ghana introduced ICT into the school curriculum in September 2007 following the recommendations of the Ghana Information and

Communication Technology for Accelerated Development (Ghana ICT4AD Policy, 2003) policy document and the Anamuah-Mensah National Education Review Committee Report (2002). Both documents highlighted the importance of integrating ICT into the curriculum at all levels.

The introduction of Information and Communication Technology (ICT) has become an essential tool that supports innovative teaching and enhances students' continuous learning process (Kirschner, 2001). For instance, Bos (2009) held that when technology is used with appropriate pedagogy in Mathematics classroom, it improves students' academic achievement. Bos (2009, p. 527) again asserted that "if Mathematics is seen as problem solving and thoughtfully teamed with technology, deep conceptual learning can be a reality". ICT learning environment gives students fluency in varieties of representational systems, provide opportunities to create and modify representational forms, develop skills in making and exploring virtual environments, and emphasizes as a fundamental way of making sense of the world (Ang & Lee, 2005; Yu, 2008). The National Council of Teachers of Education, NCTM (2003) affirmed that technology is an important tool for learning Mathematics in 21st century, and all schools must ensure that all their students have maximized the potential of technology to develop students' understanding, stimulate their interest, and increase their proficiency in Mathematics since strategically used technology provide access to Mathematics for all students.

The government of Ghana has invested huge sums of money in procurements of computers and establishment of computer labs in most Colleges of Educations. The new curriculum in Mathematics encourages teachers to make use of the calculator and the computer to help students acquire the habit of analytical thinking and the capacity to apply knowledge in solving practical problems (Ministry of Education, Science and Sports (MOESS), 2007) but it is still unclear whether these computers are being used effectively by teachers in their instruction.

The Transforming Teacher Education and Learning Programme in Ghana (T-TEL, 2014-2018) aims at transforming the delivery of pre-service teacher education in Ghana by improving the quality of teaching and learning in all Colleges of Education (MoE, 2016). In order to make use of ICT in lessons, the teaching competency for stimulating pupils' interest in lessons required both college tutors and pre-service teachers to use ICT in their lesson delivery (Trainee Teachers' Addendum, 2017).

Due to the importance of ICT in the society and possibly in the future of education, identifying the possible perceptions of the integration of these technologies in schools would be an important step in improving the quality of teaching and learning. Balanskat, Blamire and Kefala (2006) argued that although educators appear to acknowledge the value of ICT in schools, difficulties continue to be encountered during the process of adopting these technologies for their purposes. The study on *Developing Science Mathematics and ICT* (SMICT) education in Ghana suggested changes to the teacher's instructional role, from presenter of knowledge using drill-oriented methods, to participatory teaching and learning (Ottevanger, et al. 2007) recommended effective use of ICT, which needed to be optimized through extensive programs of pre-service teacher support. Agyei and Voogt (2011a, b) observed that pre-service teachers appeared generally supportive in wanting to use computers in their (future) classrooms, in spite of the barriers to technology use in instruction.

In the Needs and Priorities Survey conducted by Association of African Universities, AAU/e/merge Africa in January 2017 in the top ten African countries which Ghana was part revealed

that 77.9% of students in the Colleges and Universities needed the integration of ICT into teaching and learning (AAU, 2017).

Integration of technology in education has increasingly become an important concern in education not only in developed countries, but in developing countries as well. Agyei and Voogt (2011a) indicated that most instructors at the teacher education program were mainly dependent on lecture-based instruction. Teacher education did not include instructional technology courses to prepare prospective teachers to integrate technology in their lessons. This means that the pre-service teachers' experience in integrating technology in teaching is limited, making the program fall short of a practical approach. This leads to the question whether the trained pre-service teachers are sufficiently prepared for new teaching methods which are flexible, student-centred and involve appropriate use of technology. Agyei and Voogt (2011 b) conducted a research on Mathematics and technology education in Ghana and observed that pre-service Mathematics teachers did not integrate technology in their instruction in spite of government efforts in the procurement of computers and recent establishment of computer labs in most senior high schools. According to Ottevanger, van den Akker and de Feiter (2007), and Agyei and Voogt (2011a), major barriers to technology integration into Mathematics teaching and learning were the current teaching strategies used and lack of pre-service teachers' knowledge of ways to integrate technology in instruction resulted in chalk and talk approach in which teachers did most of the talking and intellectual work, while students were passive receptacles of the information provided.

A number of researches (Buabeng-Andoh, 2012) studied on teachers' perceptions, skills and uses of ICT in second-cycle institutions in Ghana. Agyei and Voogt (2011b) also explored pre-service mathematics teachers computer attitudes, competencies and access of the teachers on their levels of ICT integration into lessons in the university in Ghana.

However, no specific research has been conducted to explore the perception of pre-service teachers' about the use of ICT in teaching and learning Mathematics in the Colleges of Education in Ghana. It is therefore, the objectives of this study to examine the perceptions that Mathematics students in Akatsi, OLA, and St. Francis Colleges of Education have in relation to the use of ICT in the teaching and learning of Mathematics

Purpose of the Study

The purpose of the study was to explore pre-service teachers' perception about the use of ICT in the teaching and learning of Mathematics in Akatsi, OLA, and St. Francis Colleges of Education in Ghana.

Research Questions

1. What are pre-service teachers' perception about the use of ICT in teaching and learning of Mathematics?
2. What are the classroom practices of College tutors with regard to the use of ICT in the teaching and learning of Mathematics?
3. Do College tutors need professional development and training in ICT to assist them in applying ICT in the teaching and learning of mathematics?

LITERATURE REVIEW

Integrating ICT into classroom teaching and learning continue to be a challenging tasks for many teachers (So & Kim, 2009). While ICT is becoming prevalent in schools, and children are increasingly growing up with ICT, teachers' use of ICT for teaching and learning continue to be a concern for educators (Jimoyiannis, 2010; Polly, Mims, Shepherd, & Inan, 2010). Teachers feel inadequately prepared for subject-specific use of ICT and robust theoretical framework is lacking (Brush & Saye, 2009). According to Tella, Toyobo, Adika, and Adeyinka (2007) as less technologically advanced countries joined the World Links school programme in 1999-2000, the major barriers to ICT classroom was due to lack of computer hardware (60%), software (56%) and reliable internet connections (52%), particularly in African countries such as Mauritania, Ghana and Zimbabwe. Besides, lack of technical support in the schools and teachers' lack of expertise in using ICT, were the prominent factors hindering teachers' readiness and confidence in using ICT.

Teachers' perceptions on the use of ICT in classrooms

Regarding teachers' perceptions of the application of ICT in teaching mathematics, Buabeng-Andoh (2012) found that majority of the respondents perceived that integrating ICT into teaching was useful and can offer opportunities to teachers for obtaining educational resources from the internet to enrich course content and also can improve teaching and learning processes. In general teachers' perceptions of the application of ICT in teaching and learning environment were positive. Tella, Tella, Toyobo, Adika and Adeyinka (2007) examined teachers' uses of ICTs and implications for further development of ICT use in schools using a census of 700 teachers. The findings showed that most teachers perceived ICT as very useful and as making teaching and learning easier. Agyei and Voogt (2011a) investigated pre-service mathematics teachers' overall perception towards ICT integration in Mathematics lessons. Reporting on the overall perceptions of teachers' willingness to integrate ICT in lessons, an overwhelming majority of 96% pre-service teachers indicated that they were willing to integrate ICT in their future lessons.

Teachers' integration of ICT into teaching

Kaleli-Yilmaz (2015) and Demir, Özmantar, Bingölbali and Bozkurt, (2011) explored teacher views on teachers' factors affecting the integration of ICT in teaching and learning Mathematics revealed that teachers did not use technology in their lesson because they had limited knowledge on technology integration.

So and Kim (2009) examined what constitute knowledge bases that were expected for future pre-service teachers to gain related to pedagogically sound technology integration. The researchers examined the complexity of pre-service teachers' technological pedagogical content knowledge. The areas that pre-service teachers perceived to be particularly challenging and difficult was finding and integrating ICT tools and resources relevant for the target students and learning activities and designing tasks with a balance between teacher guidance and student independence. Agyei and Voogt (2011b) conducted a study on pre-service mathematics teachers and explored the influence of computer attitudes, competencies and access of the teachers on their levels of ICT integration into lessons reported of low levels of ICT integration into lessons as a result of low competencies and access levels of ICT.

Professional development and training needs

The issue of how ICT is to be covered in pre-service teacher education and in-service teacher professional development has received significant attention. Baylor and Ritchie (2002) have indicated that training has an important influence on how well ICT is embraced in the classroom. Becker (2000), found out that teachers' limited skill and expertise in using computers is an obstacle for more teachers to utilize computers frequently with their students

Brush and Saye (2009) and Kramarski and Michalski (2010) revealed in their study that teachers felt inadequately prepared for subject-specific use of ICT and robust theoretical framework was lacking.

Agyei and Voogt (2011b) investigated mathematics teachers' overall perception towards ICT integration in lessons, training needs and willingness to participate in professional development programme that integrate ICT in instruction. Reporting on the overall perceptions of teachers' willingness to integrate ICT in lessons, an overwhelming majority of 96% (very willing = 68%, willing = 28%) pre-service teachers were willing to integrate ICT in their future lessons. However, majority of the pre-service teachers (94%) were very enthusiastic to attend training to learn software for specific Mathematics to enable them integrate ICT in their Mathematics lessons.

Theoretical Framework

The purpose of the study was to provide arguments to better understand teachers' readiness of pedagogical integration of ICT and to integrate and summarize findings from a body of research on trends in ways that ICT can be understood and used to improve the quality of teaching and learning in the educational system in Ghana. Much research in the developed world has suggested many theories or models for evaluating factors that influence or constrain individual acceptance behavior on information technology and information systems, acceptance and diffusion of innovations, integration of ICT in education in general or use of ICT for teaching practice in particular. These models include the Theory of Reasoned Action, Theory of Planned Behavior, Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology, and Diffusion of Innovations. TAM proposed by Davis (1989), seems to be one of the most popular theories that is used widely to explain information system usage. TAM has been widely used to scrutinize individual technology acceptance behavior along only two factors: perceived usefulness and perceived ease of use. Mumtaz (2000) in a review study identified three factors for continued ICT integration to include institution, resources, and the teacher. In practice factors that guide human actions to change or influence technology acceptance behavior may be varied and cannot be assumed to be static. In this study, literature on factors driving integration of ICT in education included:

- Teacher preparedness and willingness;
- Professional development training and the lack of skilled human resources that support the achievement of teaching and learning with ICT; and
- Resistance to change from traditional pedagogical approaches of teaching to more innovative, technology-supported methods

METHODOLOGY

Research Design

The research made use of descriptive survey. This type of research would assist to describe the characteristics that exist in the population, but not to determine the cause-and-effect relationship. The justification for the use of the design was that it provided detailed description of pre-service teachers' perception of the use of information communication and technology in the teaching and learning of mathematics.

Population

The target population was seventeen thousand (17,000) pre-service teachers in all the fifteen (15) Science and Mathematics designated Colleges of Education in Ghana. The accessible population was three thousand three hundred and forty (3,340) pre-service teachers in three Science and Mathematics designated Colleges of Education in Ghana which were purposively selected.

Sample and Sampling Procedure

The sample consisted of two hundred and forty two (242) level 200 teacher trainees offering the special Science and Mathematics programme at Akatsi College of Education, and St. Francis College of Education in the Volta region and OLA College of Education in the Central region of Ghana. All level 200 classes offering Science and Mathematics programmes at these colleges were conveniently selected to form the sample. Levels 200 teacher trainees were selected because they had studied most causes in ICT and could be able to share their views and sentiments about the extent to which their tutors apply it in the teaching and learning of Mathematics. In addition, Science and Mathematics teacher trainees were used in the study because they were specially trained to teach Mathematics at the upper primary and the junior high school levels where the mathematics curriculum in particular emphasizes the use of ICT in the teaching and learning of Mathematics.

Instrument

A questionnaire was used to collect data for this study. The questionnaire was divided into three thematic areas namely perception about the use of ICT, current pedagogical practices and professional development and training needs of tutors. Respondents were asked to indicate their levels of agreement on perception about the use of ICT, current pedagogical practices and professional development and training needs of tutors on a four-point scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree). The scores were interpreted as follows: one is the least possible score and four is the highest. On the scale of 1 to 4, 2.5 being the median, when the mean is above 2.5 it implies the perception exists, but when the mean is below 2.5, it implies the perception does not exist.

Data Analysis

The data collected were organized and analyzed using statistical tools such as mean and standard deviation.

RESULTS

Research Question 1

What are pre-service teachers' perception about the use of ICT in teaching and learning of Mathematics?

Research Question 1 intended to solicit the views of the respondents as to whether ICT is useful in the teaching and learning of Mathematics and whether the use of ICT can help sustain the interest of students in learning Mathematics.

Table 1: Pre-service teachers' perception about the use of ICT in teaching and learning of Mathematics

	N	Minimum	Maximum	Mean	Std. Deviation
A1	242	1.00	4.00	3.2273	.57072
Valid N (listwise)	242				

Table 1 indicated that pre-service teachers perceived the integration of ICT into the teaching and learning of Mathematics as very useful (mean =3.227). A standard deviation of (S.D. = .5707) revealed that they do not differ in their perception about the usefulness of ICT in the teaching and learning of Mathematics. That is, pre-service teachers held similar views that the use of ICT in the teaching and learning of Mathematics is very useful.

Research Question 2

What are the classroom practices of College tutors with regard to the use of ICT in the teaching and learning of Mathematics?

Table 2: Pre-service teachers' perception about their tutors' integration of ICT into teaching and learning of Mathematics.

N	Minimum	Maximum	Mean	Std. Deviation
242	1.00	4.00	2.2789	.53391
242				

Table 2 showed that pre-service teachers were of the view that their teachers to a large extent do not integrate ICT into the teaching and learning of Mathematics. They disagree with the assertion that their teachers made use of ICT in the teaching and learning of Mathematics (mean = 2.279). A standard deviation of (S.D. = 0.534) revealed clearly that they do not differ in their views about the failure of their teachers in using ICT to facilitate the teaching and learning of Mathematics. That is pre-service teachers shared similar sentiments about the inability of their teachers in applying knowledge of ICT to the teaching and learning of Mathematics.

Research Question 3

Do College tutors need professional development and training in ICT to assist them in applying ICT in the teaching and learning of mathematics?

Research Question 3 sought to find out whether apart from the normal courses prescribed by the curriculum to be taught in ICT at all the levels of education, Mathematics teachers need further training courses to enable them integrate ICT into the teaching and learning of the subject.

Table 3: Teachers’ professional development and training needs in ICT courses.

	N	Minimum	Maximum	Mean	Std. Deviation
A3	242	1.00	4.00	3.3361	.56468
Valid (listwise)	N 242				

Table 3 revealed that pre-service teachers were of the view that apart from the normal courses prescribed by the curriculum to be taught in ICT at all the levels of education in Ghana, teachers need special ICT training courses to be able to effectively use ICT to facilitate the teaching and learning of Mathematics (mean = 3.336). A standard deviation of (S.D. =0.565) indicated that indeed pre-service teachers’ view on the assertion that college tutors need additional training course in ICT to enable them integrate ICT into the teaching and learning of Mathematics within the group were similar and in the affirmative.

DISCUSSION

From Tables 1, it was evident that pre-service teachers perceived the integration of ICT into the teaching and learning of Mathematics as very useful. This finding was consistent with Buabeng-Andoh (2012) and Tella, Tella, Toyobo, Adika and Adeyinka (2007) who found that most teachers perceived ICT as very useful and as making teaching and learning easier

Again, from Tables 1 and 2, it was evident that even though pre-service teachers shared similar sentiments that the use of ICT could facilitate the teaching and learning of Mathematics, their teachers were unable to integrate ICT into the teaching and learning of the subject. This finding was consistent with the study of So and Kim (2009) who found out that integrating ICT into classroom teaching and learning continue to be a challenging tasks for many teachers. It was also in concord with Agyei and Voogt (2011b) who reported in their study that low levels of ICT integration into lessons by teachers was as a result of their low competencies and access levels of ICT.

It was also revealed from Table 3 that pre-service teachers were unanimous about the view that teachers need special training courses in ICT to enable them use ICT to facilitate the teaching and learning of Mathematics. This finding gave credence to the study conducted by Becker (2000), who also found out that teachers’ limited skill and expertise in using computers is an obstacle for more teachers to utilize computers frequently with their students. Again, our

finding was consistent with the study conducted by Brush and Saye (2009) and Kramarski and Michalski (2010) which revealed that teachers feel inadequately prepared for subject-specific use of ICT and robust theoretical framework is lacking.

In addition, our finding was also in line with the study conducted by Tella, Toyobo, Adika and Adeyinka (2007) which showed that teachers' lack of expertise in using ICT and lack of technical support in the schools was the prominent factors hindering teachers' readiness and confidence in using ICT.

CONCLUSIONS

The evidence available from the findings of this study provided the basis for a number of conclusions to be made. Firstly, it was found that the use of ICT could help facilitate the teaching and learning of Mathematics. Secondly, the study also revealed the inability of college tutors to integrate ICT into the teaching and learning of Mathematics. Last but not least, it was concluded that teachers need special ICT training courses to be able to effectively use ICT to facilitate the teaching and learning of Mathematics.

RECOMMENDATIONS

Based on the findings and the conclusions, the following recommendations were made.

1. The National Council for Tertiary Education in close collaboration with the Ministry of Education and other stake holders of Education should organize special ICT training courses for college tutors in the field from time to time to equip them with those special skills and knowledge needed to enable them integrate ICT into the teaching and learning of Mathematics in order to facilitate the processes.
2. The Government of Ghana in collaboration with the Ministry of Education should provide training opportunities in special ICT courses to teachers teaching at all levels of education to equip them with those special skills and knowledge to enable them use ICT to facilitate the teaching and learning of Mathematics.
3. The teacher training institutions in Ghana in collaboration with the Ministry of Education and Curriculum, Research and Development Division should fashion out special ICT courses into the curriculum to equip teachers with those special skills and knowledge to enable them use ICT to facilitate the teaching and learning of Mathematics.

Implications for Research

The study sought to encourage the teacher training institutions to design and implement the curriculum that would support the use of ICT in the teaching and learning of mathematics. Again, the study aimed at encouraging both teachers and students to acquaint themselves with the use of the computer and softwares that would enable them integrate ICT in the teaching and learning of mathematics in order to facilitate the processes. The study is also aimed at encouraging the stakeholders of education in Ghana to see the need to give training opportunities in ICT to teachers in Ghana to equip them with special skills and knowledge that

would enable them use ICT to facilitate the teaching and learning of mathematics. Last but not least, the study sought to remove the phobia associated with the use of the computer and softwares among tutors and students, add to the existing literature and also serve as basis for further research.

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