The Use of Information and Communication Technology (ICT) in Teaching and Learning of Mathematics in Al-Faruq College of Education, Wenchi-Ghana

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Abstract: *The purpose of this study was to assess the use of Information and Communication Technology (ICT)with emphasis on the level of Mathematics tutors' ICT Competency in teaching; tutors' pedagogical practices with ICT; and the barriers to overcome when using ICT in teaching of Mathematics in Al-Faruq College of Education, Wenchi-Ghana. A cross-sectional descriptive survey was used for the study with questionnaires being the main tools to collect the data. The analysis suggests that Mathematics tutors' ICT competency level is low, but they still do their best. The findings also indicted that tutors seldom use the appropriate pedagogy in relation to the use of ICT in teaching Mathematics. More so, respondents are aware of the benefits of good pedagogical practices in a lesson. Finally, it was found that tutors are challenged with a lot of ICT barriers that include absence of training opportunities and infrastructure when using ICT in the teaching and learning of Mathematics in the College. The study recommends frequent trainings and the removal of ICT barriers in the College for the tutors to give students the required knowledge and skills.*

Keywords: ICT, competency, pedagogy, affordances

1. Introduction

Information and Communications Technology (ICT) permeates every activity in the world, and in school curriculum Mathematics is no exception. Information and Communications Technology (ICT) and Mathematics are bed fellows, therefore, cannot easily be separated. Mathematics at a certain level is more abstract, hence need technology to link abstractness to real-world settings. ICT assists in resolving real- world issues, through application software such as the Spread sheet and Matlab as it provides a dynamic and proactive teaching-learning environment for students (Arnseth and Hatlevik, 2012). Information and Communications Technology (ICT) also offers many tools that could be used in the classroom to improve teaching and learning quality (Hussain, Morgan, and Al-Jumeily, 2011). Ghana introduced ICT into its education system in September, 2007, as a result of the Anamouah -Mensah Education Review Committee Report (2002).Beside its introduction, an ICT for accelerated development policy was put in place (Ghana ICT4AD Policy Document, 2003). The rationale for integrating ICT into all levels of Ghana's education curriculum was to speed up the acquisition of quality knowledge and skills by learners for rapid development of the state. In teaching and learning mathematics, ICT is essential as it improves the way mathematics should be treated and increases students understanding of basic concepts (Ittigson and Zewe, 2003). The use of ICT in teaching of Mathematics should therefore be dependent on the tutor's ICT competency level, the nature of pedagogical practices and how innovative the tutor will be in resolving the barriers.

1.1. Research Problem, Objectives and Aim

According to deGraft-Yankson (2010),Information and Communication Technologies (ICTs) often provide tutors and learners the desired environment to be innovative and creative in all aspects of the curriculum and ensure that basic knowledge and skills of computing form part of the core of education. That is why every country in the world has introduced ICT into the educational curriculum, and Ghana is no exception. Information and Communication Technology (ICT)has been a core subject just like Mathematics, English, Integrated Science and Social Studies since September,2007.In order to create an enviable education system that could provide the required ICT knowledge and skills for the citizenry, where the society could use the ICT tools in their daily activities, Ghana government spent $ 11 million United State dollars on the former 38 government owned colleges of education ICT laboratories, training teachers, recruitment of staff, and the provision of ICT facilities in the hinter land amongst others (Iddrissu, 2009). It is sad to note that Al-Faruq College of Education has not received any support from the government regarding ICT since its establishment in 2016apart from support from Non-Governmental Organisations (NGOs) such as Iqra Foundation and the National Investment Bank (NIB).With the acknowledgement of ICT establishment in the colleges of education, to improve the system, and make teaching and learning better, there still remains a gap in the state of using ICT in handling Mathematics as well as the Sciences. Most tutors use ICT in their lessons without the necessary knowledge and skills in its usage, while others have the requisite skills and knowledge to use ICT, but are faced with inadequate computers and projectors. Therefore,

the state of ICT usage in Al Faruq College of Education still raises serious questions, which need to be answered:

- What contributes to the current state of ICT usage in the college?
- Are the tutors at the college given the required training in ICT usage?
- How adequate are the ICT facilities in the college?
- What is the attitude of tutors towards the ICT usage in the college?
- What is the level of knowledge content (technological and pedagogical) of tutors in teaching mathematics with ICT?

Among others, these are investigated in this write up.

Consequently, the study tries to examine Mathematics tutors' ICT Competency level in using ICT in their respective lessons. It will also assess their pedagogical practices regarding the use of ICT in the teaching and learning processes. Finally, the barriers to the use of ICT in the College are enumerated. The outcome of the study is aimed at assisting tutors to integrate ICT very well at all levels in the classroom; provide tutors an extrinsic motivation in teaching and integrating the subject effectively; simplify instruction as well as eliminate rote learning; The outcome will also assist educational authorities to effectively organize in-service training for tutors regarding the use of ICT in education. The findings are expected to serve as a document to guide tutors and students as to when and how to integrate ICTs into classroom teaching and learning processes.

2. Literature Review

The related literature review is on tutors' ICT knowledge, skills and practices regarding the use of ICT in teaching Mathematics in Al-Faruq College of Education. The relevant literature is focused on the following sub headings: Tutors' ICT Competency level, Tutors' Pedagogical Practices and Barriers in Using ICT.

2.1 Teachers' ICT Competency Level

Competence is the degree of meeting the standards or requirements and training to perform a task easily. Tondeur, Valcke, and Braak (2008) consider ICT competence as the use of a variety of computer applications to solve problems. Tutors' ICT competence refers to their ability to use technology in relation to pedagogy with the understanding that positive results could be derived by learners due to the various strategies employed (Krumsvik, 2007). Tutors select appropriate ICT tools based on when and how to use; and why they select a particular tool regarding the strategies and specific lesson objectives planned to be achieved. Tutors who have low ICT competency are often nervous and try to avoid using computers with the slightest challenge. While teachers with high level of ICT competency and experience often use computer technology (Agyei, 2012).This is why Smarkola (2008) observed that for effective use of ICT in the teaching and learning of Mathematics, tutors need to be technologically competent and not just ICT literate. The writer (Smarkola, 2008) considers teachers' ICT competency level to be his/her ability to use the required tools to integrate curriculum for learners to explore and develop their potentials. In view of the fore going, tutors of

Al-Faruq College of Education need to be examined in order to establish whether their competency level is a barrier to the use of ICT in teaching Mathematics, or they simply possess the knowledge but failed to integrate ICT into their practices.

2.2 Teachers' Pedagogical Practices

Pedagogy may be considered as the methods of teaching and organization of students for learning situations. This view when upheld requires thorough investigation of tutors' ideas, values, beliefs and the capacity to reason that leads to evidence in practice (Mary and Cox, 2004). In ICT education, the teacher, student and the whole learning environment should be considered for effectiveness. Tutors planning to present materials to learners need to determine what resources and approaches to apply that will enable learners to develop the requisite concepts, attitudes and skills.

Effective pedagogical practices require tutors to identify affordances such as buttons, icons, menus, check boxes in any software and other resources that could assist in exploring the ideas, concepts and skills to be treatedin their lesson specific objectives to create an enabling environment for both teachers and learners to enhance effectiveness (Mary and Cox 2004). Girgin, Kurt and Odabasi (2011)assert that tutors' knowledge in the curriculum application in their respective subject areas as well as instructional practices enhances effective use of ICT in the teaching and learning mathematics. Pedagogical practices involving the use of a variety of ICT tools in teaching and learning mathematics require collaboration. Tutors' knowledge in the application of these technologies, their attitude and belief, the learners and the environment within which the teaching and learning will take place must be taken into consideration for pedagogical effectiveness.A combination of teacher-centered approach, learner-centered approach and situational or contingency approaches to teaching and learning are also needed.

2.3 Barriers in Using ICT

The usage of ICT in teaching and learning has many benefits, however, tutors often feel reluctant to use ICT due to: deficiency in tutors' knowledge and skills in using the technology; inadequate time allotted to ICT classes in the school; absence of ICT training available for tutors to upgrade themselves; lack of technical support; inadequate knowledge of tutors regarding strategies to use in integrating technology into the curriculum; difficulty in using verities of ICT tools in a specific lesson; absence of ICT resources such as computers, digital projectors, visualizers and effective internet connectivity for students to use and the age of the tutor, since many old tutors are unwilling to use new technologies in teaching (Daher, Baya'a, and Anabousy, 2018).For Bitner and Bitner (2002) barriers to ICT usage should be considered in the form of support networks available to the school, such as tutors' support, internet connection, administrative support, technical support and students' support. These support systems are the main foundation on which the ICT usage in a college will succeed. According to Lundell and Howell (2000), factors

hindering the integration of technology in schools include: inadequate funds for purchasing ICT software applications and the most recent antivirus installation; fewer computers for larger classes and absence of computer knowledge and skills of some teachers. The above views explain some of the challenges to the usage of technology in the teaching and learning processes. As a result, innovative ways of delivering lessons via ICT to enhance learners' understanding by Mathematics teachers is affected negatively. It is imperative to find out if these barriers exist and whether they account for Al-Faruq College of Education tutors' inability to integrate ICT into the teaching and learning of mathematics.

3. Research Methodology

The research design for the study was cross-sectional descriptive survey. The descriptive survey is appropriate when examining practices (Kumar, 2011; Creswell, 2009). The questionnaire was based on three components; tutors 'ICT competency level, tutors' pedagogical practices and barriers in using ICT. Even though the target population for the study was one hundred and sixty-five (165) students and four (4) tutors, purposive sampling technique was used to include all the four (4) Mathematics tutors in the College. Eighty (80)year-three students were also purposively selected because they had stayed longer in the college than the other year groups, and would be in a better position to tell their story about ICT usage and the tutors as well. Hence, out of the 165 students in the mathematics department, 80 students and four tutors constituted the sample population for the study.

3.1 Reliability of Instruments

The survey instrument was a four Point-Likert type questionnaire. The interpretation was:1 = strongly disagree; 2 = disagree; 3 = agree and 4= strongly agree to make data analysis easy. The same interpretation was used for all constructed items. The Cronbach alpha (α) reliability was conducted and was found to be .725 for the 15 items, suggesting a very high reliability of acceptance.

4. Research Analysis and Discussion

What is the level of Mathematics tutors' ICT Competency in the use of ICT in teaching and learning Mathematics?
The first research question attempts to find out the level of Mathematics tutors' ICT Competency in the use of ICT in teaching and learning Mathematics in the College. The findings obtained on the field are shown in Table 1.

Table 1: Mathematics Tutors' ICT Competency level

Statement	N Valid	Range	Mean	Mode	Std. Deviation
1. Mathematics tutors feel confident in teaching with computer knowledge and skills.	4	1	2.50	2	.577
2. Educators are able to Protect the computer from virus, spyware, adware, malware, hackers, among others	4	1	3.50	2	.577
3. Tutors often used interactive software for students to experiment and discover knowledge and skills.	4	1	2.50	2	.577
4. The tutors do not use both handheld devices and whole class display technology during teaching	4	1	3.00	2	.816
5. Mathematics tutors do not have the skills to use appropriate ICT tools in teaching different mathematical topics	4	1	2.50	2	.577

Field Data, 2018
Grand Mean = 2.80

From Table 1, the Grand Mean score for the items is 2.8. This shows that every tutor responded very well to the statements. Additionally, the range value of (1) shows that all the five items were given equal attention. The N Valid 4 indicates that all the respondents had enough data on the variable to respond to the demands of the objective; therefore, no response was missing. To assess the level of Mathematics tutors' ICT Competency in the use of ICT in teaching and learning of Mathematics in the College, descriptive statistics was employed. The Mode value of (2) suggests low level of Mathematics tutors' competency in using ICT in their lessons as shown in Table 1. This confirms Agyei's (2012) assertion that teachers with high level of ICT competency and experience often use technology. Thus, effective and efficient use of computers in the class room depends on the level of ICT competency of a tutor. The findings is also in line with the opinion of Smarkola (2008) that for effective use of ICT in the teaching and learning Mathematics, tutors, need to be technology competent and not just ICT literate in order to give of his or her best in using the new technology. In short, it seems to suggest that tutors with the required ICT competency could integrate Mathematics with ICT easily without difficulty. But, the analyses suggest low level of tutors' competency in using ICT.

In Table 2: Also, shows the findings obtained from students, regarding tutors' ICT competency level in integrating Mathematics with ICT.

Table 2: Students' Response to Tutors' ICT competency

Statement	N Valid	Range	Mean	Mode	Std. Deviation
1) Tutors do not feel confident in teaching with computer.	80	3	2.76	3	.846
2) Educators are able to Protect the computer from virus, spyware, adware, malware, hackers, among others.	80	3	3.14	3	.896
3) Tutors seldom used interactive software for students to experiment and discover knowledge and skills.	80	3	2.80	3	.986
4) The tutors do not use hand held devices and	80	3	3.00	3	.955

	N				
digital projectors during teaching					
5) Mathematics tutors do not have the skills to use appropriate ICT tools in teaching different mathematics topics	80	3	2.69	3	.922

Field Data, 2018
Grand Mean =2.88

From Table 2, the Grand Mean score for the itemsis2.88. Thus every student responded well to the statements. Besides, the range value of (3) shows that all the five items were given similar attention. The N Valid (80) indicates that all the respondents had enough data on the variable to respond to the demand of the research question' therefore, no response was missing. Descriptive statistics was used to find out the level of Mathematics tutors' ICT Competency in the use of ICT in teaching and Mathematics. The Standard Deviation value close to(1) and the Mode of (3)suggest low level of Mathematics tutors' competency in using ICT in their lessons since the students agreed to that effect. In sum both tutors and students' responses suggest low tutor ICT competency.

To what extent do tutors employ Pedagogical practicesin teaching Mathematics with ICT in the College?

The second research question was meant to assess the pedagogical practices of tutors in teaching Mathematics with ICT in the College. The analysis of the data concerning this objective is presented in Table 3.

Table 3: Tutors' Pedagogical Practices in using ICT

Statement	N Valid	Range	Mean	Mode	Std. Deviation
1) Lack of technology usage do not encourage students' active participating in the lesson.	4	1	3.25	3	.500
2) Tutors do not use ICT often in their lessons to encourages students communication with their classmates	4	1	2.75	3	.500
3) The use of ICT helps to broaden students' knowledge and skills	4	1	3.75	4	.500
4) Lack of technology integration hinders data Processing and analyzing	4	1	3.50	3	.577

Field Data, 2018
Grand Mean=3.44

From Table 3,the tutors responded to the statements very well. The Grand Mean of 3.44 and similar Standard Deviation values suggests that majority of the tutors' pedagogical practices is low in using ICT in Mathematics lessons. This gives credence to the study conducted by Girgin, Kurt and Odabasi (2011) that tutors' knowledge in the curriculum application in their respective subject areas as well as instructional practices enhances effective use of ICT in the teaching and learning of mathematics. Additionally, Mary and Cox (2004) added that effective pedagogical practice requires the tutor to identify affordances in any software and other resources that could assist in exploring and developing the ides, concepts and skills to be treated. In conclusion, the analysis seems to suggest that tutors' seldom use the right pedagogical practices in their lessons. However, tutors pedagogical practice depends on the knowledge of the curriculum as well as the content knowledge to be able to select the require software in order to create the right environment to apply ICT in a lesson.

The findings obtained from students, regarding tutors' Pedagogical practices of Mathematics tutors' in teaching Mathematics with ICT in the College are shown in Table 4.

Table 4: Students' Response to Tutors' Pedagogical Practices

Items	N Valid	Range	Mean	Mode	Std. Deviation
1) Lack of technology usage do not encourage students' active participating in the lesson.	80	3	2.81	3	.969
2) Tutors do not use ICT often in their lessons to encourages students communication with their classmates	80	3	2.93	3	.897
3) The use of ICT helps to broaden students' knowledge and skills	80	3	3.06	3	.919
4) Lack of technology integration hinders data Processing and analyzing	80	3	3.40	4	.722

Field Data, 2018
Grand Mean=3.05

In Table 4 all the 80 students responded to the statements very well. With a range and mode values of 3 respectively the students' responses to the items were satisfactorily. The Grand Mean of 3.05 suggests that majority of the tutors' pedagogical practices is low in using ICT in Mathematics lessons. From Table 3 and Table 4 it can be concluded that that tutors' pedagogical practices is on the low side.

What are the barriers to the use of ICT in teaching Mathematics in the College?

The third research question was to examine to the use of ICT barriers in teaching Mathematics in the College. The findings are shown in Table 5.

Table 5: Barriers of ICT in the College

Statement	N Valid	Range	Mean	Mode	Std. Deviation
1) The curriculum does not provide adequate time for tutors to use ICT in teaching and learning Mathematics	4	1	3.50	3	.577
2) Absence of technical support in the use of ICT tools in teaching and learning	4	1	3.50	3	.577

Mathematics					
3) Absence of training opportunity for tutors to integrate ICT in Mathematics.	4	1	3.50	3	.577
4) Tutors do not have enough time to use ICT in Mathematics lessons.	4	2	3.00	3	.816
5) Absence of ICT infrastructure in the College (e.g. internet, computers, projectors and application soft wares).	4	1	3.75	4	.500
6) Inadequate funds available in the College.	4	1	3.75	4	.500

Field Data, 2018
Grand Mean=3.50

In Table 5 the Grand mean score for the items is 3.5, suggesting that tutors' responses to the instruments was good relative to the ICT barriers in the College. The Mode value of (3) suggests serious hindrances to the use of ICT in teaching Mathematics in the College. This confirms Bitner and Bitner's (2002) study that support networks available to the school, tutors' support, internet connections, administrative support, technical support and students support constitute challenges. The use of ICT in the teaching and learning of Mathematics in the College depend on these supports systems.

Also, this finding give credence to earlier works of Lundell and Howell's (2000) which indicated that inadequate funds, fewer computers and absence of computer knowledge and skills for some teachers were ICT challenges. It implies that ICT barriers often hinder effective ICT usage in the teaching and learning of Mathematics. In sum, the ICT barriers in the teaching and learning of Mathematics are many in the College, hence, ineffective usage of the technology in the teaching and learning processes. Empirical evidence shows that ICT barriers contribute to poor integration of the technology.

Views from students, regarding the barriers to the use of ICT in teaching and learning of Mathematics in the College was gathered for further analysis as shown in Table 6.

Table 6: Students Response to ICT Barriers

Statement	N Valid	Range	Mean	Mode	Std. Deviation
1. The curriculum does not provide adequate time for tutors to use ICT in teaching and learning Mathematics	80	3	2.69	3	1.143
2. Absence of technical support in the use of ICT tools in teaching and learning Mathematics	80	3	3.38	4	.817
3. Absence of training opportunity for tutors to integrate ICT in Mathematics.	80	3	3.19	3	.695
4. Tutors do not have enough time to use ICT in Mathematics lessons.	80	4	3.28	3	.729
5. Absence of ICT infrastructure in the College (e.g. internet, computers, projectors and application soft wares).	80	3	3.01	4	1.061
6. Inadequate funds available in the College	80	3	3.06	4	1.083

Field Data, 2018
Grand Mean=3.10

From Table6, the Grand Mean of the statements is3.1 Most of the items also have a range score of 3 with their mode values around 3. The implication is that, all the 80 students responded well to the statements and that all the six items were given similar attention. Therefore, given the descriptive statistics from Table 6, it can be concluded that there are serious barriers to the use of ICT in teaching and learning of Mathematics in the College. The students unanimously agreed and strongly agreed to the existence of ICT barriers to the teaching and learning of Mathematics in the College. In sum both tutors and students' response seems to suggest there are ICT barriers to the teaching and learning of Mathematics in the College.

5. Findings

The findings of this study are as follows:
1) The level of Mathematics tutors' ICT Competency in the use of ICT in teaching and learning Mathematics.
a) Majority of the respondents show low ICT competency of tutors in the use of ICT in teaching Mathematics.
b) Some tutors do not have the required skills to use appropriate ICT tools in teaching Mathematics.
c) Tutors are not aware of the appropriate ICT applications to be used in their lessons.

2) Tutors' pedagogical practices in teaching Mathematics with ICT in the College.
a) Tutors seldom use the right pedagogical practices in teaching Mathematics in the College.
b) The respondents are aware of the appropriate use of pedagogy to promote active participation of teaching and learning in the class room.
c) The analyses also show how effective use of pedagogy in the class room promotes sharing of ideas among learners through communication.
d) It was also found that, good pedagogical practices broaden learners' knowledge and skills.

3) The barriers to the use of ICT in teaching and learning Mathematics in the College.
a) There is absence of technical support to the use of ICT in teaching and learning of Mathematics in the College.
b) There are inadequate training opportunities for tutors to integrate the technology into their lessons in the College.
c) There is inadequate ICT infrastructure in the College for tutors and learners.
d) Tutors do not devote time to the use of ICT application in mathematics.

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6. Conclusion

The purpose of the study was to assess the level of Mathematics tutors' competency in the use of ICT in teaching and learning Mathematics; their pedagogical practices in the teaching and learning process as well as the ICT barriers they encountered during the use of ICT in teaching and learning of Mathematics in Al Faruq College of Education. From the analysis, it is concluded that the tutors' ICT competency level in using ICT to teach Mathematics is low. Tutors also show seldom use of the right pedagogical practices in teaching Mathematics. Finally, ICT barriers, in the College, hindering the integration of ICT in the teaching and learning of Mathematics in the College are many.

7. Recommendations

The study recommends training opportunities for the mathematics tutors to enable them use the technology effectively in their lessons. Beside, tutors should always use the appropriate pedagogy in their lessons to promote effective teaching and learning. Finally, the management must improve on the ICT infrastructure in the College for effective and efficient lesson delivery.

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