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USAGE OF ICT TOOLS IN THE TEACHING AND LEARNING OF MATHEMATICS IN THE BASIC SCHOOL CLASSROOM

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Abstract:
ICT (Information and Communication Technology) is an important part of the teaching and learning process. This study investigates the usage of ICT tools in teaching Mathematics and the problems associated with the use of using these tools to teach. The study also sought to find out the relationship between the gender of teachers and their usage of ICT tools. A simple random sampling was used to sample the respondents for the study. The study's findings revealed Mathematics teachers in the basic schools do not integrate ICT tools during teaching and learning. However, lack of computers, inadequate training and lack of access to the internet was also revealed to be some of the key barriers to the successful integration of ICT tools in the teaching and learning of mathematics. Findings from the study further revealed that male teachers integrate ICT tools in their teaching more than their female colleagues. It is recommended that the study should be conducted in other regions in Ghana or the senior high schools and the results be compared with our research. Also, workshops should be organized for teachers to teach and encourage them to integrate ICT effectively during their teaching and learning.

Keywords: information communication technology, developmentally appropriate practices, ICT tools

1. Introduction

Human history has seen a tremendous advancement, especially in the field of education. The education sector over the years has seen a significant improvement. And curriculum

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developers all over the world, especially in Ghana have been advocating for a developmentally appropriate practice (Essuman, Korda & Essigyan, 2021) in the teaching of Mathematics in our basic schools. And literacy in Information communication technology is part of these developmentally appropriate practices suggested by curriculum developers and Essuman et al. (2021). The term "Information and Communication Technology", according to Dhakal (2018), is the form of technology that is used to transmit, create, store, share or exchange information between or among people. Radio, television, video, telephone (both fixed-line and mobile phones), satellite systems, computer and network hardware and software, as well as equipment and services associated with these technologies, such as video conferencing and electronic mail, are all included in this broad definition of ICT (Iahad, Shallsuku & Oye, 2012). The coronavirus pandemic led to a halt in teaching and learning during the lockdowns. The closure of schools during covid-19 did not only affect learners, teachers and families but also affected every country's economy. This disruption in education shed much light on the importance of ICT in teaching and learning as most schools moved to the digital space for teaching and learning (Owusu-Fordjour, Koomson & Hanson, 2020).

Teachers are the lifeblood of any community. Teachers' training programs benefit greatly from technological advancements. Learners gain knowledge and information via television, digital media, cable networks, the internet, and social media platforms like Facebook, Twitter, WhatsApp, LinkedIn, Igo, Line, and WeChat. In the twenty-first century, ICT is critical for pre-service teacher education programs. Without sufficient ICT expertise, a teacher will be unable to perform in his or her classroom, and he or she will not be considered complete.

The classroom environment is evolving. There is a technological divide between societal growth and teacher instructional activities in the classroom. If we look at our culture, we can see how technology has transformed our society yet teaching and learning activities at the school level have remained largely unaffected by technology. In contemporary classrooms, knowledge is conveyed by the teacher in an antiquated manner, a teacher-centric model that is often boring and fails to boost the learners' attention during the teaching and learning of Mathematics in the basic schools. However, education in the 21st century is centred on the student. This makes the role of the teacher change from being the only knowledgeable person in the class to impart knowledge to being a facilitator or a guide for learners. The recent advances in the world make it essential for teachers to integrate ICT during their teaching to boost the interest of learners and prepare them for the outside world. For this reason, this study sought to find out how often teachers use ICT tools in their teaching and also find out the challenges they face during the integration of ICT tools.

2. Research Questions

The following research questions guided the study.

1) How often do basic school Mathematics teachers use ICT tools during teaching and learning?
2) What are the problems teachers encounter during the integration of ICT in the basic school Mathematics classroom?

3. Research Hypothesis

H_0: There is no statistically significant relationship between gender and the use of ICT in the basic school Mathematics classroom.

H_1: There is a statistically significant relationship between gender and the use of ICT in the basic school Mathematics classroom.

4. Literature Review

The Ministry of Education (MoE) of Ghana, the National Council for Curriculum and Assessment (NaCCA) advocate for the reinvention of the approaches to teaching and learning, and the management of schools seek to prepare learners to keep up with the rapid growth of technology in the world at large. Therefore, the GES encourage schools to equip themselves with appropriate levels of technology according to their capacities.
The traditional classroom, i.e. one-way communication, is being replaced by two-way communication. Teachers and learners now take part in classroom discussions. Education nowadays is centred on the child. As a result, the teacher should be prepared to deal with various forms of technology to use them in the classroom to make teaching and learning more engaging. Technology becomes the right medium for implementing some student-centric techniques such as project-based learning, which puts learners in the role of active researchers. ICT has enabled better and faster communication, as well as a more effective and relevant presentation of ideas.

4.1 Importance of ICT integration in the teaching and learning of Mathematics

ICT tools help to promote high-quality courses by increasing student motivation, connecting learners to a variety of knowledge sources, supporting active in-class and out-of-class learning settings, and allowing instructors to devote more time to facilitation.

Furthermore, technological gadgets can be utilized to achieve experiences that are either inaccessible or only accessible through time-consuming and frequently tiresome labour in regular life. According to Ittigson & Zewe (2003), technology is critical in the teaching and learning of mathematics. ICT boosts student knowledge of basic ideas and improves the way Mathematics should be taught. Many studies have been conducted to assess the advantages of utilizing ICT in mathematics. Becta (2003) summed up the main advantages: ICT fosters communication and knowledge exchange among learners and promotes increased collaboration among them. ICT provides learners with immediate and precise feedback, which leads to positive motivation. It also allows them to spend

less time on boring computational computations and more time on tactics and interpretations of answers.

Dhakal (2018) indicated that the use of ICT in education allows learners and teachers to experience new ways of learning. With various unprecedented events occurring in our lives, e-learning or online learning is becoming increasingly popular and enlightening us on new ways of approaching teaching and learning. This not only allows schools to ensure that learners have access to curriculum materials while in the classroom but also allows them to ensure that learners outside the classroom, such as at home or in hospitals, can learn.

4.2 Challenges in the integration of ICT in teaching and learning Mathematics

Teachers have a variety of hurdles when it comes to gaining access to new technologies, which vary country by country. Integration of ICT tools into the teaching and learning of Mathematics is a complex process that can be fraught with challenges. Any circumstance that makes progress or achievement of an objective difficult is referred to as a challenge.

Limited access and poor network connection, schools with limited ICT facilities, ineffective training, limited time, and lack of teachers' competency are factors that impede the successful integration of ICT in the teaching and teaching process, according to Venkatesh and Davis (2000), and this is no different than the teaching of Mathematics in Ghanaian primary schools.

A study conducted by Empirica (2006) showed that the most significant barrier to adopting ICT in education is a lack of access, and teachers have cited a variety of challenges, including a shortage of computers and suitable material. Similarly, Korte and Hüsing (2007) discovered that various infrastructure limitations exist in European schools, such as the lack of broadband connectivity. According to their findings, a third of schools in Europe still do not have access to high-speed Internet.

According to Pelgrum (2001), four of the top 10 impediments are related to ICT accessibility. Inadequate computer units, peripherals, software copies, and immediate Internet connectivity were among the difficulties. Low computer numbers, obsolete or slow ICT systems, and a lack of software in the school, according to Toprakci (2006), are all hurdles to successful ICT implementation in schools. Also, Al-Alwani (2005) discovered that having no access to the internet services during the school day and a inadequate computer accessories hampered technology integration. One of the most significant barriers to technology integration in the classroom was a lack of computer resources (Albirini, 2006). These barriers/challenges are not different from Ghanaian basic schools. Most basic schools in the country lack basic amenities like common desks and ICT tools, so this makes it practically difficult to integrate ICT into the teaching of Mathematics in the basic schools.

4.3 Gender difference and use of ICT

Gender differences in ICT use at home and school, according to studies, play a crucial influence (Janssen & Plomp 1997). In both primary and secondary school, guys use computers for a larger range of activities than females, according to Janssen and Plomp (1997). Males have more access to and use of ICT tools than females, according to Durndell and Thomson (1997). Also, according to Volman and van Eck (2001), females have lower computer literacy than males due to limited access to ICT, and a lack of skills, experience, and enthusiasm for using ICT tools. Males use more ICTs in learning than females, according to Kay (2006), because males have more free time to practice it.

5. Methodology

5.1 Research Approach and Design

The data received from all of the respondents were collected and analyzed using quantitative methods in this study. The researcher created and finalized a questionnaire before distributing it to the target set of responders. The questionnaire was created to answer research questions about teachers' use of ICT technologies in basic schools.

5.2 Instrumentation and Sampling

A questionnaire was adapted for this study. The questionnaire was in 3 sections, the section A, B and C. The questionnaire was based on a 4-point Likert scale ranging from 4 = Always, 3 = Sometimes, 2 = Rarely and 1 = Never. And the section C ranged from: 1 = Strongly Disagree; 2 = Disagree; 3 = Agree; 4 = Strongly Agree. According to Ary, Jacobs, & Razavieh (2002), the Likert scale is one of the most widely used techniques to measure descriptive survey studies. In terms of the 4-point Likert scale used, which makes the average score to be 2.5 [(1+2+3+4) ÷4], the determination of the frequency of teachers' involvement in play in the Mathematics classroom. The statistical mean of <2.50 indicated low usage of ICT tools, between 2.50 and 3.50 indicated a moderate usage and greater than 3.50 indicated a high usage of ICT in the teaching and learning of Mathematics. A total of 250 basic school teachers were randomly selected for the study. The respondents responded to the statements given in the questionnaire and chose their answers based on how frequent they use ICT tools and to what extent they agree with the statements. The various sections of the questionnaire included: (A) Demographics, (B) Usage of ICT tools in the basic school Mathematics classroom, and (C) Challenges of using ICT tools in the basic school Mathematics classroom.

6. Results

6.1 Demographics of Respondents

Two hundred and fifty teachers from the basic schools were sampled for the study. The figure below presents the gender distribution of the respondents

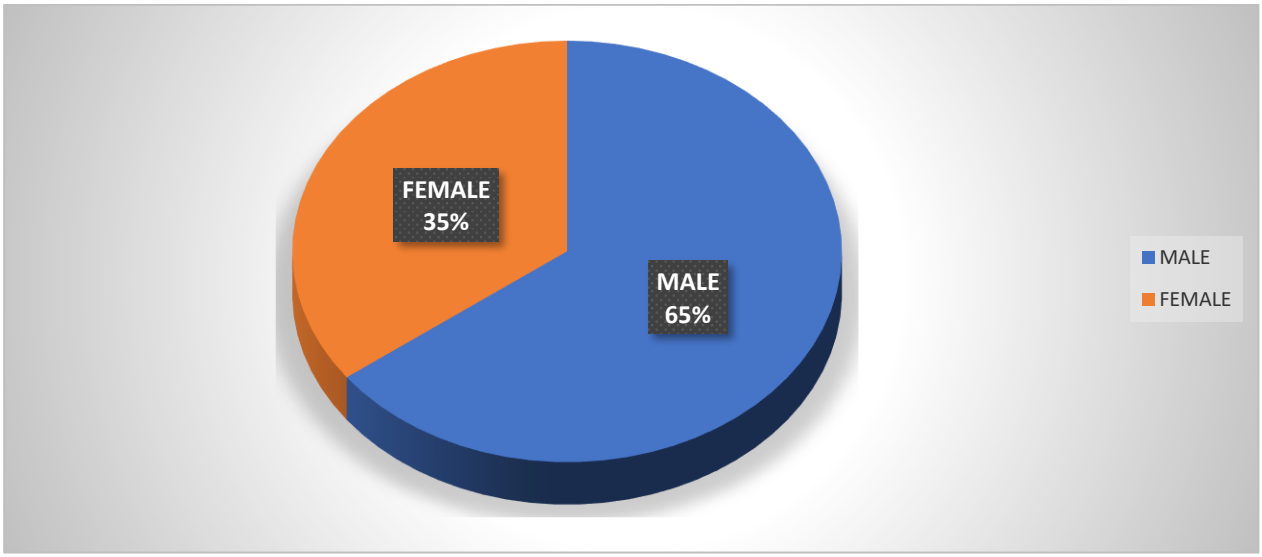

Figure 1: Gender of Respondents

From Figure 1 above, 65% of the respondents were males while 35% were females. This is to say that males in the basic schools used for the study are more than their female colleagues.

6.2 Educational Qualifications

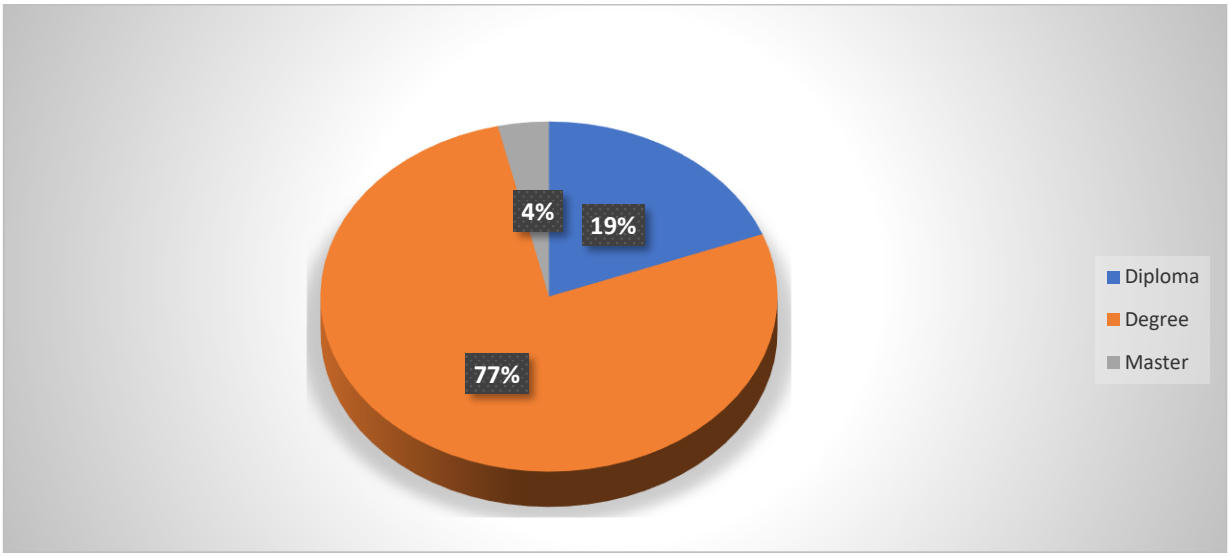

Figure 2: Educational Qualification of Respondents

Results from Figure 2 above indicated that 19% of the respondents had a diploma in education while 77% had a degree as their highest educational qualification and the remaining 4% have a master's degree as their highest academic qualification.

Research Question One: How often do basic school Mathematics teachers use ICT tools during teaching and learning?

This research question sought to find out how frequent Mathematics teachers in the basic school use ICT tools during their teachings.

Table 1: Usage of ICT tools

	Uses of ICT Tool	**Never (%)**	**Rarely (%)**	**Sometimes (%)**	**Always (%)**
1	Use a spreadsheet for data analysis	190 (76.0)	35 (14.0)	12 (4.8)	13 (5.2)
2	Use YouTube videos during teaching	110 (44.0)	62 (24.8)	68 (27.2)	10 (4.0)
3	Email a file to someone, another student or a teacher	155 (62.0)	72 (28.8)	21 (8.4)	2 (0.8)
4	Download and install the software on the computer	109 (43.6)	87 (34.8)	49 (19.6)	5 (2.0)
5	Prepare materials to use with an interactive whiteboard	198 (79.2)	38 (15.2)	14 (5.6)	0 (0.0)
6	Download curriculum resources from/to website or learning platforms for learners to use	11 (4.4)	84 (33.6)	143 (57.2)	12 (4.8)
7	Prepare a PowerPoint presentation with either video or audio clips	54 (21.6)	80 32.0)	98 (39.2)	17 (6.8)
8	Use Excel or any software in teaching	190 (76.0)	14 (5.6)	32 (12.8)	14 (5.6)
9	Use MS Word to facilitate teaching and learning	9 (3.6)	42 (16.8)	146 (58.4)	53 (21.2)
10	Participate in social networks	12 (4.8)	6 (2.4)	120 (48.0)	112 (44.8)

Results from Table 1 indicated that 190(76.0) of the respondents indicated that, they have never used a spreadsheet for data analysis, 35(14.0) said they rarely use a spreadsheet for data analysis during the teaching of mathematics, 12(4.8) sometimes used and 13 (5.2) of then said the always used spreadsheet for data analysis. The Table also showed that 110(44.0%) of the respondents never used YouTube videos during a teaching in the Mathematics classroom, 62(24.8%) rarely used, 68(27.2%) of them sometimes used and the remaining 10 (4.0%) of them said they always used YouTube in their teaching and leaving.

The table further indicated that more than half (62.0%) of the respondents have never sent an email to a colleague or a teacher and 198 (79.2%) of them have never prepared materials to use with an interactive whiteboard. But 11 (4.4%) of the respondents indicated that they have never downloaded curriculum resources from/to the website or learning platforms for learners to use; 84(33.6%) rarely download or upload curriculum materials for learners to use.

Furthermore, Table 1 indicated that 53(21.2%) of the respondents always use MS Word to facilitate teaching and learning, and 146(58.4%) of them sometimes used it. But 42(16.8%) of the respondents rarely use MS Word to facilitate teaching and learning and 9(3.6%) of the respondents never Use MS Word to facilitate teaching and learning. Also,

190(76.0%) of the respondents indicated that they have never used excel in their teaching. But as many as 112(44.8%) of the respondents participate in social networking to improve their teaching approaches.

Research Question Two: What are the problems teachers encounter during the integration of ICT tools in the basic school Mathematics classroom?

This research question sought to find out the problems or barriers associated with the use of ICT tools in the basic school Mathematics classroom. The results of the data collected are revealed in Table 2 below.

Table 2: Barriers to the Integration of ICT in the teaching of Mathematics

	Barriers	**SD (%)**	**D (%)**	**A (%)**	**SA (%)**	**M (Std.)**
1	Limited access to computers and projectors	0 (0.0)	0 (0.0)	9 (3.6)	241 (96.4)	3.9 (0.2)
2	Inadequate time in college schedule for projects involving ICT	1 (0.4)	12 (4.8)	93 (37.2)	144 (57.6)	3.5 (0.6)
3	Not enough access to the Internet	0 (0.0)	11 (4.4)	116 (46.4)	123 (49.2)	3.4 (0.6)
4	Inadequate knowledge about how to integrate ICT to enhance curriculum	21 (8.4)	14 (5.6)	197 (78.8)	18 (7.2)	2.8 (0.7)
5	Unavailability of Mathematical software	11 (4.4)	15 (6.0)	14 (5.6)	210 (84.0)	3.6 (0.8)
6	Lack of technical support for ICT tools	0 (0.0)	0 (0.0)	52 (20.8)	198 (79.2)	3.8 (0.4)
7	Learners do not have access to the necessary technology at home	8 (3.2)	26 (10.4)	154 (61.6)	62 (24.8)	3.1 (0.7)
8	Teachers do not have access to the necessary technology at home	5 (2.0)	20 (8.0)	86 (34.4)	139 (55.6)	3.4 (0.7)
9	Inadequate training, seminar, workshop and talk program in ICT	6 (2.4)	62 (24.8)	82 (32.8)	100 (40.0)	3.1 (0.9)
SD = Strongly Disagree; D = Disagree; A = Agree; SA = Strongly Agree; M = Mean; Std = Standard Deviation						

Source: Field Data 2022.

According to the results from Table 2, 241(96.4%) of the respondents strongly agreed that there is limited access to computers and projectors in their schools for the teaching of Mathematics and 9(3.6%) of them agreed with this assertion. A mean and standard deviation score of (M=3.9; Std=0.2) indicated that all the respondents agreed with this assertion. The table also showed that 144(57.6%) of the respondents strongly agreed that there was not enough time in the college schedule for projects involving ICT, 93(37.2%) of the respondents agreed with this statement as they believed that their difficulty to integrate ICT tools in teaching Mathematics because of the limited training they had during their time in teacher training schools but 12(4.8%) of them disagreed and 1(0.4%) strongly disagreed. A mean and standard deviation of (M=3.5; Std=0.6). Mean and

standard deviation scores of not enough accesses to the Internet (M=3.4; Std=0.6), Unavailability of Mathematical software (M=3.6;0.8), lack technical support for ICT tools (M=3.8, Std=0.4). the table also revealed that 62(24.8%) strongly agreed with the assertion that learners do not have access to the necessary technology at home and 154(61.6%) of the respondents agreed, but 26 (10.4%) disagreed and 8(3.2%) strongly disagreed to this statement. Finally, 100 (40.0%) of the respondents strongly agreed that teachers have inadequate training, seminar, workshops and talk program in ICT and 82 (32.8%) agreed with this statement but 62 (24.8%) of the respondents disagreed with this statement and the remaining 6 (2.4%) of the respondents strongly disagreed. A mean and standard deviation score of (M=3.1; Std=0.9) indicated that at least 3 out of four respondents chosen agree that teachers need more training, seminar, workshop and talk programs in ICT.

5.3 Research Hypothesis

H_0: There is no statistically significant relationship between gender and the use of ICT in the basic school Mathematics classroom.

H_1: There is a statistically significant relationship between gender and the use of ICT in the basic school Mathematics classroom.

This hypothesis sought to find out if there exists a relationship between the gender of a teacher and the usage of ICT tools in the teaching of mathematics.

Table 3: Independent Sample t-test

	Levene's Test for Equality of Variance		t-test for Equality of Means						
	f	Sig.	t	df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal Variances assumed	.063	.817	.183	98	.862	.040	.229	-.415	.495
			.183	41.31	.863	.040	.230	-.424	.504

Table 4: Statistics of Gender

	Gender	N=250	Mean	Std Deviation	Std. Error Mean
G3	Male	170	2.04	.982	.115
	Female	80	2.08	.991	.199

Results from Table 3 revealed the independent t-test means, it showed that the use of ICT tools in teaching and learning in the classroom of the male (M =2.04, SD = .982) is greater than that of their female colleagues (M = 2.04, SD = .991) was statistically insignificant, t= .183, *df*.= 98, p = .0005, however, since the alpha value ($p < .05$), the alternate hypothesis is accepted over the null hypothesis, and the means of the two groups are statistically significantly different from each other. That is, there is a statistically significant

connection between gender and ICT use in primary school Mathematics classes. As a result, the data provide sufficient evidence to suggest that males use ICT tools in the classroom for teaching and learning at a higher rate than females.

6. Discussion and Recommendation

Information Communication Technology (ICT) affects our everyday life and, therefore affects the teaching and learning process. The outbreak of COVID-19 was a real eye-opener to how important it is to integrate ICT tools in our teaching. The use of ICT in Mathematics education improves the effectiveness of the teaching process as well as the learners' capacities to understand basic concepts and logic. That is why it is important to integrate it into the teaching and learning process. This study aimed at finding how often teachers integrate ICT tools in the teaching and learning of Mathematics and also find out the factors that impede this integration.

Even though most Mathematics instructors in the tested schools had been trained to integrate ICT into their profession, this study found that ICT use in instructional delivery was negligible. And this was obvious during the Covid-19 lockdown, when no public basic school in Ghana could not move their lessons online. Data from the study indicated that the integration of ICT tools in the teaching and learning of Mathematics is very low.

The study further revealed that inadequate time in college schedule for projects involving ICT, not enough access to the internet, inadequate of knowledge about how to integrate ICT to enhance curriculum, lack of technical support for ICT tools are some of the barriers that impede the integration of ICT in the teaching and learning of Mathematics in basic schools. These findings are in agreement with the study of Albirini (2006), as he indicated that, one of the most significant barriers to technology integration in the classroom was a lack of computer resources. Also, limited access and poor network connection, schools with inadequate ICT facilities, lack of effective training, limited time, and low competency level of teachers are all factors that impede the successful integration of ICT in the teaching and learning process (Venkatesh & Davis, 2000). Their findings are no different than the teaching of Mathematics in Ghanaian primary schools. Results of the data further revealed that males use ICT tools in teaching Mathematics more than their female colleagues. This confirms the study of (Durndell & Thomson, 1997; Volman & van Eck, 2001; and Kay, 2006), as it was revealed in their study that males use more ICT tools during teaching and learning than females as males have more free time to practice ICT. The study revealed this situation is not that different among Ghanaian basic school Mathematics teachers. It is recommended that, workshops should be organized for teachers to teach and encourage them to integrate ICT effectively during their teaching and learning. Also, the government and relevant stakeholder should put in much effort to provide various basic school with ICT tools for successful integration with the curriculum specifically Mathematics. Finally, the researchers recommend that,

the study should be conducted in the senior high schools and the results be compared with our research.

Conflict of Interest Statement
The authors declare no conflicts of interest.

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