



Integrating ICT in teaching and learning of mathematics at Queens SHS

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Abstract

The use of information and communication technology (ICT) in teaching and learning process, particularly in mathematics, has become significant. The main objective of this study was to determine how ICT can be used to support teachers and students in teaching and learning of mathematics at Queens SHS. A set of questionnaires was designed and administered to 100 sample respondents. 90 students and 10 mathematics teachers. The analysis showed that Queens SHS has enough ICT infrastructure and strong access to ICT facilities based on the high means and standard deviations recorded by both mathematics teachers and the students. By analysing and interpreting the data from the perspectives of both teachers and students, it was determined that Queens SHS mathematics teachers and students have easy access to ICT facilities and are familiar with the software that can be used to integrate ICT into the teaching and learning of mathematics.

Keywords

ICT facilities, ICT software, Infrastructure, Mathematics teachers, Teaching and learning, Students, Queens SHS, Mathematics education.

Introduction

Information and Technology Communication (ICT) in the classroom has been impacted by teachers' digital literacy and understanding of how to incorporate it into the curriculum. Information and Communication Technology (ICT) advances and societal transformation have drastically transformed how people think, work and live (Grabe, 2007). Competence is defined as the extent to which one satisfies the standards or requirements as well as the training necessary to complete a task effectively. Information and Communication Technology (ICT) rapid development

has ushered in a new era in education, especially in mathematics teaching and learning with adjustments like the change from traditional to new learning, information delivery to information exchange and teacher-centred to student-centred teaching and learning. According to Tondeur et al. (2008), ICT competency is the capacity to address issues employing a variety of computer programs. The term "teachers' ICT competency" refers to their ability to use technology in pedagogy with the hope that students will benefit from the various strategies used. When, how, and why teachers decide to use particular ICT tools will depend on the methods and particular educational goals they are trying to accomplish. ICT-challenged teachers are typically uneasy and try to avoid using computers as much as they can. High ICT skill and experience teachers are more likely to use computers. Smarkola (2008) argues that in order to effectively use ICT in the teaching and learning of mathematics, teachers need to be technologically competent as well as ICT literate. According to a study by Jamal (2013) on how Shobhit University's teachers and researchers use ICT, the article recommends adequate training and guidance for using ICT-based technologies in order to ensure that users are using these services to their fullest potential. The Shobhit University is situated in a remote area in western India, where few students are aware of the use of ICT in library services. The findings demonstrate that we have not yet arrived at the critical stage for institutional supply of ICT infrastructure. A better pre-service ICT education for future teachers is required in light of this predicament. The term "pedagogy" refers to teaching strategies and groupings of students for optimal learning environments. When this point of view is validated, it calls for a thorough evaluation of teachers' attitudes, values, and capacities for reasoning, which results in evidence in practice (Mary and Cox, 2004). According to Girgin et al (2011), teachers' knowledge of curricular application in their specific subject areas as well as instructional strategies are key to the effective use of ICT in the teaching and learning of mathematics. In order to effectively teach and learn mathematics, collaboration is essential in the pedagogical methods used. Teachers' knowledge of how to use these tools, their attitude and beliefs, the students, and the environment in which teaching and learning will take place must all be taken into account for pedagogical effectiveness. In all nations that adopt a constructivist design philosophy for their educational systems, ICT use in the education sector has grown significant. Ghana's educational system has made an effort to change how ICT is used in the classroom. This field has been adopted by the educational system to boost both your ICT proficiency and your teaching style. The connection between the use of ICT and the achievement of instructional goals, as well as the effect of ICT on teachers' perspectives of their work is significant in this area (Barzel & Drijvers, 2009). Even though there are many benefits to use ICT in teaching and learning, teachers are usually hesitant to do so because they lack the knowledge and skills to use the technology. Lack of ICT resources like computers, digital projectors, visualizers, and reliable internet connectivity for students to use, the teacher's age, and insufficient time allotted to ICT classes in school (Daher et al., 2018). Although earlier studies have demonstrated the advantages of ICT use in the classroom, there are still challenges that must be overcome. According to Schweizer (2006), student mobility, unique needs, and exam result anxiety are the biggest problems with ICT use. These problems can be resolved by providing sincerer group and problem-based learning activities as well as enough learning support (Whelan, 2008). In order to lower student hurdles and improve the effectiveness of ICT use in the classroom, Aleman et al (2011) contend that government support, infrastructure development,

capacity training, curriculum development, and infrastructure are all essential. Communications networks, electrical grid networks, and other ICT-related hardware, software, and services are all included in ICT infrastructure (Gesci, 2007). According to Akinsola et al. (2005), there are two categories of ICT infrastructure: Hardware consists of devices like computers, phones, LAN networks, hubs, printers, scanners, TVs, fax machines, codec cameras, projectors, radios, video, CD, and audiotape players, as well as micro-phones. The ICT infrastructure's software component consists of Windows and Microsoft office. The components of this infrastructure include "a collection of hardware, software, services, protocols, processes, and people." Infrastructure accessibility is essential when considering how best to employ ICT in education. ICT uptake and utilization in teaching, learning, and research are all positively benefited. Infrastructure plays a key role in how quickly ICT expands. Similar to how transportation and energy are significant components of the basic infrastructure, it is viewed as a critical factor (McCredie, 2003). ICT infrastructure is highly dependent on technological infrastructure, so increasing access to all types of technology will increase the availability of ICT infrastructure. This is the key to comprehending why ICT infrastructure is necessary in many businesses today, especially in the educational sector. If training is inadequate or inappropriate, teachers won't be confident enough to utilize technology to its fullness in the classroom and outside of it. Teachers using ICT may encounter obstacles due to a lack of teacher competency and a corresponding severe lack of high-quality teacher training. In order to increase students' understanding, this has a significant impact on the creative ways that mathematics teachers present lessons using ICT. This paper therefore, determined whether these restrictions are real and whether they are to blame the mathematics teachers at Queens SHS inability to incorporate ICT into teaching and learning of mathematics.

Methodology

This study uses a mixed technique approach, using quantitative methods followed by qualitative methods. Quantitative research was the early step of the research. In this study, the researcher used a paper survey design for the first phase. Individual and social facts, views, thoughts, and views are best obtained through survey research. As a result, the researcher used a survey study design to learn about students' opinions on the use of ICT in teaching mathematics. To ensure the viewpoint, the researcher used a qualitative technique to analyse the data collected from the interview in the second part on the research questions. ICT integration in mathematics instruction and learning at Queens Senior High School was the focus of the study. Queens SHS is the sole girl's SHS in the Western North of Bibiani-Anhwiaso - Bekwai Municipal and has a total enrolment of 540 students. In this study, convenience sampling method was used to distribute questionnaires to all the 10 mathematics teachers in the department of mathematics at Queens SHS as well as to the 90 students. Convenient sampling is a non- probability sampling technique in which the sample is taken from the population where "Yes" and "No" were the alternatives and students were allowed to select at random to avoid bias making 100 sample of both teachers and students. From the viewpoint of the students and the teachers, five points Likert Scale with the value as 5-Strongly Agree, 4-Agree, 3- Undecided, 2-Disagree and 1- Strongly Disagree. Some respondents completed the surveys immediately after they were

distributed, while the others were collected after 1-2 days. The researcher used the Statistical Package for Social Sciences (SPSS) software version 21.0. The SPSS was used to performed a descriptive analysis where both mean and standard deviation were computed on the questionnaire.

Results

Demographic information of the respondent

Basically, this is the data gathered about the respondents' backgrounds. The discussion part includes information on gender, age, the professional qualifications of teachers, the subjects they teach, the teachers' ranks, and the nature of employment. Tables 1 to Table 5 list the gender, age, professional qualification and rank of each teacher and students' age.

Table 1: Gender Distribution of Teachers

Gender	Frequency(N)	Percentage (%)
Male	8	80
Female	2	20
Total	10	100

Source: Fieldwork (2022)

10 mathematics teachers in total took part in the study, as shown in Table 1 above. Out of this total, eight (8) respondents, or 80% of the respondents, are male, while two (2) respondents, or 20% of the respondents, are female.

This clearly shows that males predominate among mathematics teachers at Queens SHS.

Table 2: Age Distribution of Teachers

Age	Frequency(N)	Percentage (%)
10 - 20	0	0
21 - 30	2	20
31 - 40	8	80
41 - 50	0	0
51 - 60	0	0
Total	10	100

Source: Fieldwork (2022)

The age range of the study's mathematics teachers is shown in Table 2. The data show that the majority of respondents eight (8) were between the ages of 31 - 40 (representing 80%); the next majority two (2) were between the ages of 21 – 30 which also represent (20%). Ages 10 -20, 41 – 50 and 51 - 60 did not answer. This demonstrates and supports the fact that the mathematics teachers at Queens SHS who were able to use ICT are the young and energetic ones, with an average age of 36.

Table 3: Professional Qualifications of Teachers

Professional Qualification	Frequency(N)	Percentage (%)
Diploma	0	0
Degree	9	90
Masters	1	10
Phd	0	0
Total	10	100

Source: Fieldwork (2022)

According to the Table 3 above, out of 10 respondents, 90% had a degree whereas only one, or 10% of them, had a master's degree which indicates that, the mathematics teachers at Queens SHS are well educated even though none of them had PHD qualification.

Table 4: Rank of Teachers

Rank	Frequency(N)	Percentage (%)
Senior superintendent	2	20
Principal superintendent	4	40
Assistant Director II	3	30
Assistant Director I	1	10
Total	10	100

Source: Fieldwork (2022)

Table 4 above shows that, the majority of the teachers (4) representing 40% were at the principal superintendent rank, followed by (3) representing 30% were at the Assistant director II rank, while (2) representing 20% were at the senior superintendent rank and (1) representing 10% were at the rank of Assistant director I.

Table 5: Age Distribution of Students

Age	Frequency(N)	Percentage (%)
11 - 15	13	14.4
16 - 20	51	56.7
21 - 25	24	26.7
26 - 30	2	2.20
Total	10	100

Source: Fieldwork (2022)

Table 5 above breakdown of students' ages reveal that the majority (51) representing 56.7% were in the 16 - 20 age range, while (24) students, or 26.7% were in the 21 -25 age range, (13) students representing 14.4%, were in the 11 - 15 age range and 2 representing 2.20% being the least fell between the range of 26 - 30.

Current Status of ICT Infrastructure at Queens SHS

The ICT infrastructure at Queens SHS is currently in a very good state, as well as students, teachers, and administrators have access to the equipment and resources they need to teach efficiently with ICT. In order to answer (RQ1), the researcher computed means and standard deviations for each of the two constructs: Queens SHS mathematics teachers and students' access to ICT facilities and familiarity with ICT software. The Table 6 below shows the response mean, standard deviations (SD), and amount of accessibility to ICT facilities for teachers.

Table 6: Mathematics teachers access to ICT facilities.

Items	Mean	S.D
Personal Computer	4.10	1.197
Computer Laboratory	4.30	0.949
Computers in the library	3.10	1.663
Computers in the staff common room	2.10	1.449
Internet Connectivity	4.10	0.316
Access to Pc at school	4.00	0.817
Access to Pc at home	4.10	0.568
Overall access to ICT facilities	3.69	0.994

Source: Fieldwork (2022)

The level of access to ICT facilities among teachers at Queens SHS is reported in Table 6 above. It is clear that teachers have access to ICT facilities and equipment.

(mean=4.10, SD=1.197), teachers of mathematics have a lot of access to personal computers; (mean=4.30, SD=0.949), teachers have a lot of access to the computer lab; (mean=3.10, SD=1.663), teachers have access to computers in the library that they use for research while classes are in session; (mean 2.10, SD= 1.449); teachers have access to computers in the staff common room, (mean=4.10, SD=0.316), teachers have strong access to the internet through the school's computer network, (mean=4.10, SD=0.568), teachers have strong access to their home computers, which they use to practice activities. As a result, the findings imply that, the status of ICT infrastructure at Queens SHS is adequate.

The uses of ICT in Teaching and Learning of Mathematics at Queens SHS

How can ICT be used to support teachers and students in teaching and learning of mathematics at Queens SHS? As a way to ascertain this, the research examines teachers and students familiar with ICT software. Table 7 below illustrates mathematics teachers familiar with ICT software and their rating means and standard deviations.

Table 7: Mathematics teachers familiar with ICT Software

Item	Mean	SD
Internet	4.20	0.632
Spreadsheet	4.00	0.817
Databases	3.60	1.174
Word processor	3.70	1.059
PowerPoint	3.60	0.966
Mathematical game	3.40	0.966
Overall familiarity	3.75	0.936

Source: Fieldwork (2022)

From Table 7 above, it is seen that mathematics teachers are familiar with ICT software, (mean=4.20, SD=0.632), teachers are with a very high familiar with internet, (mean=4.0, SD=0.817), mathematics teachers are familiar with spreadsheet, (mean=3.60, SD=1.174), teachers are familiar with databases, (mean=3.70, SD=1.059), teachers are familiar with word processor, (mean=3.60, SD=0.966), teachers are familiar with PowerPoint, (mean = 3.40, SD=0.966), teachers are well familiar with mathematical game. The findings and interpretations above show that ICT applications may be utilized to improve mathematics teaching and learning at Queens SHS since teachers are familiar with them and are able to use them.

Students Perspectives

The tables below summarize the discussions and results of the students' responses about access to ICT facilities and familiarity with ICT software. The students access to ICT facilities is shown in Table 8 below, together with the rating means and standard deviations.

Table 8: Students access to ICT facilities

Item	Mean	SD
Personal computer	11.4	3.85
Computer laboratory	10.87	4.09
Computer in the library	7.93	5.96
Internet connectivity	10.81	4.35
Overall access	10.94	3.88

Source: Fieldwork (2022)

The findings from the Table 8 above substantially support the claim that students have strong access to ICT facilities, personal computer, computer laboratory, computer in the library and internet connections. The results so far support that, the status of ICT infrastructure at Queens SHS is high. The means and standard deviations of students familiar with ICT software are also shown in Table 9 below.

Table 9: Students familiar with ICT software

Item	Mean	SD
Internet	9.47	3.42
Microsoft word	12.13	2.69
Microsoft excel	11.86	2.81
Microsoft PowerPoint	11.39	2.98
Overall familiarity	11.22	2.98

Source: Fieldwork (2022)

The findings from Table 9 above demonstrate that, students are familiar with ICT software, internet, Microsoft word, Microsoft excel and Microsoft PowerPoint, and it is apparent that ICT can be used to support teachers and students in teaching and learning of mathematics at Queens SHS.

Discussion and Conclusion

The study's core idea was to determine how ICT can be used to support teachers and students in teaching and learning of mathematics at Queens SHS. According to “Will, Skill, Tool and Pedagogy” (WSTP) model, a teacher needs sufficient ICT infrastructure and easy access to ICT tools and facilities in order to integrate ICT in the teaching and learning of mathematics in the classroom. The study's two main research topics served as its guide. In accordance with the research questions and literature review from chapter 2 of this study, the important findings are discussed in this part. The purpose of the RQ1 was truly built to find out from the respondents whether Queens SHS has adequate or inadequate ICT infrastructures (equipment). The analysis showed that Queens SHS has enough ICT (infrastructure) equipment based on the high means and standard deviations recorded by both the mathematics teachers and the students. A study conducted by Krumsvik (2007) suggested that, teachers with limited ICT tools and equipment are normally uneasy and strive to avoid integrating ICT in teaching. The results of this study therefore support those findings by providing evidence that Queens SHS has adequate ICT facilities for both students and teachers' usage. The purpose of RQ2 was also designed to ascertain and examine the teachers and students familiar with ICT software. The analysis showed that, both mathematics teachers and students have strong access to ICT facilities. According to Girgin et al (2011), a successful use of ICT in teaching and learning of mathematics in classroom is possible when both teachers and students are familiar with ICT software and this demonstrated that, mathematics teachers and students of Queens SHS are familiar with ICT software. The focus of this study is to integrating ICT in teaching and learning mathematics at Queens SHS. Yes or No option as sampling technique was employed to select 30 students from year one, 30 from year two and 30 from year three to avoid biasness and all the 10 mathematics teachers making 100 sample. The instrument used to collect data were 5-point Likert scale questionnaires. With the use of SPSS, the questionnaire forms were analyzed. Descriptive statistics, including means and standard deviations were employed to the teachers and students access to ICT facilities and familiar with ICT software. According to the findings, Queens SHS teachers and students have good access to ICT sources and are knowledgeable about ICT software, both of which realistically help to integrate ICT in teaching and learning mathematics.

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