



Teachers' Use of ICT Facilities in Mathematics Education

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Abstract

Mathematics education is a crucial component of a well-rounded education, providing students with essential problem-solving skills and critical thinking abilities. Utilization of ICT in the teaching context has had a major positive impression, especially on teachers. ICT facilities are now used as a tool for mathematics teaching and learning to satisfy the needs of both teachers and learners. This study aimed to investigate teachers' technology use in Mathematics Education in four selected public secondary schools. The study employed a survey design. A straightforward random selection method was used to select and include fourteen individuals in this investigation. The data presented was gathered through questionnaires. Using percentage and mean, the information that was collected was examined. Fourteen mathematics teachers that were selected for the study had an average mean of 3.68, revealing that the majority of secondary mathematics teachers use of ICT facilities to support the teaching of mathematics. To increase the use of ICT facilities in secondary schools, it is advised that teachers keep utilizing technology in the classroom. The findings of this study contribute to the existing body of research on effective ICT utilization in Mathematics Education.

Introduction

The various ICT facilities used in the teaching and learning process include computers, the internet, electronic notice boards, digital multimedia, overhead projectors, optical fibers, fax machines, and so on (Babajide & Bolaji, 2003). The potential for communication technologies to transform teacher development models and processes in less developed countries (LDCs) is enormous, allowing access to quality resources and accomplished support (Leach, 2003; Leach & Moon, 2002). The introduction of undersea fiber-optic cables that connect the entire world through the internet has contributed to the advanced development of ICT in the twenty-first century, transforming the world into a global village (Deepak & Turner, 2006). ICT offers a variety of opportunities for mathematics teaching and learning at all levels of education (Joshi, 2017; Munyengabe, Haiyan, & Yiyi, 2018; Osondu, Ogbonna, & Umeh, 2022). In India, there is a critical need to use ICT to improve students' capacity for learning (Rani & Anisha, 2017). The ongoing, universal digital revolution of the early 21st century has been characterized by the combination of technology and human development, where traditional classroom instruction has been modified for the new digital environment (Scherer, Siddiq, & Tondeur, 2019).

It is first necessary to update the conventional teaching-learning approaches to educate students to be lifelong learners and successful contributors to their communities (Aggarwal & Gupta, 2020). Technology plays a vital

role in teaching and learning mathematics (Ittigson & Zewe, 2003; Osondu, Ogbonna, & Umeh, 2022). There was little ICT use in the delivery of instruction. The government and other important stakeholders should work hard to equip the various basic schools with ICT tools for efficient integration with the teaching and learning process. The use of ICT in mathematics education increases the efficiency of the teaching process as well as the student's understanding of fundamental concepts (Essuman, Korda, Essigyan, Febiri, & Aboagye, 2022) ICT in education policies frequently emphasizes the need for schools to have adequate resources that teachers can use to enhance and improve the quality of students' learning (Mukama & Andersson, 2008). ICT has become one of the most influential in modern society, and they have a significant impact on all aspects of school operations. Including time management, lesson delivery, evaluation, and the examination process. With the help of IT, teaching and learning have become more practical and relevant for students (Rani & Anisha, 2017).

ICT is still being underutilized to support mathematics instruction (Amuko, Miheso, & Ndeuthi, 2015; Mugiraneza, 2021; Osondu, Ogbonna, & Umeh, 2022). Future researchers are advised to look into how ICT is used in teaching and learning, as well as challenges that may have arisen (Rani & Anisha, 2017). An evaluation of the effects of technology integration in teaching and learning processes is necessary for the digital transformation of educational systems (Osondu, Ogbonna, & Umeh, 2022; Valverde-berrocoso, Acevedo-borrega, & Cerezo-pizarro, 2022).

Literature Review

Use of ICT Facilities in Mathematics Teaching

Teachers need in-service courses in both learning mathematics with calculators and ways of teaching mathematics when calculators are available for student use. The rapid development of calculator technology has created a gap between how school mathematics is typically taught without calculators and how it might be taught in the presence of calculators in doing and communicating mathematical ideas (Bright, Waxman, & Williams, 1994) the use of calculators as ICT tools has advanced quickly. The spread of personal computing devices like calculators and the availability of software allowing numerical or formal computation and geometry have greatly improved the tools used by students in mathematics courses (Dawn, 2002). The researchers conducted a study comparing participants' use of calculators versus their heads to solve multiplication problems. The study found that, depending on how useful a solution is, people's methods for solving problems completely change. The study concluded that the calculator would function more effectively if it was portable (Walsh & Anderson, 2009).

Teachers and students can use the internet to gather knowledge, concepts, and data; access resources for downloading; interact directly with interactive content, and communicate mathematically with others (Sue & Pimm, 2004). The globalization of today's world and the critical need for information about every region, the internet plays the most significant role in ICT. Without the internet, today's devices would be nothing more than dumb terminals. Through quick and efficient means of communication, the internet and electronic devices have made the entire world easily accessible (Aggarwal & Gupta, 2020). Positive effects ICT tools can have on students' learning and the potential they have to improve mathematics instruction (Dawn, 2002).

Effective Communication and Motivation of Using ICT Facilities in Mathematics Teaching

Mathematics deals with real-life situations in our daily activities, effective schools have good mathematics infrastructures that are essential for teaching and learning (Ojose, 2011). It improves knowledge, abilities, performance, achievement, self-learning capacity, and communication skills; develops problem-solving skills; is motivated to learn; and promotes mathematical understanding, fun learning, and engagement with mathematical concepts. It also benefits the development of permuted pedagogical skills, teaching efficiency, professional skills, content knowledge, and teaching skills, as well as teaching, communication, adjustment, and other related skills of teachers. Therefore, it should be heavily utilized by all teachers and students in their teaching-learning activities (Joshi, 2017).

Students today are motivated to learn mathematics when it is taught using interactive techniques and ICT tools. The use of technology enhances and brings life to the learning environment (Aggarwal & Gupta, 2020). Information technology utilized for information processing, manipulation, and communication is often referred to as information communication and technology (Abdi, Waititu, & Mugo, 2021). In primary and secondary schools, mathematics teachers do not integrate ICT into their lessons (Essuman, Korda, Essigyan, Febiri, & Aboagye, 2022). The study's findings indicated that students could focus on the exploration by using ICT facilities and would need less time to complete the laborious computation. The study made clear that every level of education must address the issue of the necessity of integrating ICT facilities into mathematics instruction. ICT-based mathematics instruction is crucial because it encourages cooperation between teachers and students (Baharuddin, Khairiyah, & Yudariah, 2012). ICT facilities appear to have a greater influence on mathematics teaching than previously thought (Mati & Haruna, 2020).

In terms of motivation, learning enjoyment, ICT proficiency, teamwork abilities, performance, and students' outcomes have improved (Twining, 2001; Twining, 2002) students appear to be using the latest technologies more and more frequently, demonstrating the slow evolution of organizational design. Numerous studies have found that due to the lack of ICT facilities, there is little to no effect of ICT use on students' mathematics performance (Valverde-berrocoso, Acevedo-borrega, & Cerezo-pizarro, 2022). Teachers' self-efficacy in using technology to teach mathematics is influenced by their demographic characteristics (Njiku, Mutarutinya, & Maniraho, 2022). According to the above authors, ICT facilities assisted students in communicating effectively, being motivated, seeing mathematical concepts in action, and connecting ideas in concrete ways. They also gave students a connection to the practices they engage in on a daily basis. This study is guided by the following search question: To what extent do the teachers use the available ICT facilities to teach mathematics in four selected public secondary schools?

Methodology

The study investigated teachers' technology use in Mathematics Education. The survey design was used for the study. A questionnaire that the investigators created was used to gather data. However, as the resources from this body of research were more concentrated on computers in general, such as resources with a concentration on

mathematics as well as technological tools that are widely readily available and beneficial to Rwandan instructors were also created. The new survey's items were all closed-ended questions. Using a Likert rating scale of one to five, the participants graded their apparent level of knowledge and ability. whereby (1) never use what is mentioned, (2) rarely use what is mentioned, (3) the mentioned item is sometimes used, (4) the mentioned item is often used, and (5) the mentioned item is usually used. Prior to the study, the questionnaire underwent pilot testing, and its determined internal consistency reliability coefficient was 0.79, establishing item content validity involved the thinking out loud method. In the Gasabo District of Rwanda, four public secondary schools were purposefully chosen for the study. Each mathematics teacher in the chosen schools received a questionnaire. The questionnaire was distributed to 14 math teachers as a sample, and all 14 of these participants returned it. Of the 14, 8 men (57.14%) and 6 women (42.86%) who taught mathematics took part in the survey. Three (21.42%) of the teachers had experience between 0 and 5 years, whereas 11 (78.58%) had more than 5 years of experience. There were 9 teachers (64.29%) with a bachelor's degree, compared to 5 teachers (35.71%) with a diploma. Data Analysis SPSS, or the Statistical Packages for Social Science, was used to analyze the data for this study.

Findings and Discussion

The purpose of research question was to identify the use of the available ICT facilities to teach mathematics. With the guidance of the mean, the data were analyzed. Five categories of answers were used to categorize respondents' use of ICT facilities by mathematics teachers, including (1) never use what is mentioned, (2) rarely use what is mentioned, (3) the mentioned item is sometimes used, (4) the mentioned item is often used, and (5) the mentioned item is usually used. Respondents were asked to rate their schools on a five-point scale based on how frequently different ICT facilities were used for teaching mathematics in their schools. The average responses from the respondents were interpreted as follows: "1.00-2.49 indicates unused responses from the respondents on the issue, 2.50-3.49 indicates the neutral response of respondents, and 3.50-5.00 indicates used responses from the respondents on the issue raised through a questionnaire." The results are displayed in Tables 1-5. Additionally, the information gathered from respondents through questionnaires was supported by structured interviews.

Table 1. The Use Calculators as ICT Facilities to teach Mathematics

Use of calculators	1	2	3	4	5	Mean	Analysis
I am confident to support my students in learning mathematics using calculators.	0.0%	0.0%	0.0%	21.4%	78.6%	4.79	Used
I facilitate my students in performing mathematical calculations using calculators	0.0%	0.0%	0.0%	28.6%	71.4%	4.71	Used
I encourage my students to use calculators when performing mathematical operations.	0.0%	0.0%	0.0%	14.3%	85.7%	4.86	Used
Average mean						4.78	Used

From Table 1, I am confident to support my students in learning mathematics using calculators ($M = 4.79$). The item in issue is used regularly in 21.4% of cases and usually in 78.6%. That item is therefore used at school. I facilitate my students in performing mathematical calculations using calculators ($M = 4.71$). 28.6% of participants stated they frequently use the item in question, while 71.4% say they use it regularly. This indicates that the item is used in schools. I encourage my students to use calculators when performing mathematical operations ($M = 4.86$). When asked how often they use the item, 14.3% of participants said they do, while 85.7% say they do so frequently. This clearly shows that the item is utilized in teaching mathematics. The results are consistent with the findings of Walsh and Anderson (2009), who conducted a study comparing participants' use of calculators versus their heads to solve multiplication problems. According to the study, people's approaches to problem-solving completely alter depending on how useful a solution is. The study concluded that a portable calculator would work better.

Table 2. The Use the Internet as an ICT Facility to teach Mathematics

Use of the internet	1	2	3	4	5	Mean	Analysis
I use the internet to update my lessons on teaching mathematics.	0.0%	0.0%	21.4%	50.0%	28.6%	4.07	Used
I'm using the internet to research mathematical proofs and demonstrations.	0.0%	0.0%	7.1%	71.4%	21.4%	4.14	Used
For communication purposes, I use the internet at school.	0.0%	0.0%	0.0%	35.7%	64.3%	4.64	Used
Internet use for educational purposes is common among students at school.	57.1%	28.6%	14.3%	0.0%	0.0%	1.57	Unused
I am aware that technology can assist me in understanding many mathematical concepts.	0.0%	0.0%	7.1%	57.1%	35.7%	4.29	Used
Average mean						3.74	Used

From Table 2, I use the internet to update my lessons on teaching mathematics ($M = 4.07$), 0.0% of people never use the things mentioned; 0.0% use them once in a while; 50% use them often; and 28.6% use them regularly. It is concluded that the item is utilized at a school. I'm using the internet to research mathematical proofs and demonstrations ($M = 4.14$), when an item is mentioned, 0.0% of people never use it; 0.0% do so infrequently; 7.1% do sometimes; 71.4% do so often; and 21.4% do so usually. It is determined that the item is used to teach mathematics. For communication purposes, I use the internet at school ($M = 4.64$), The item in issue is used often (35.7%) and usually (64.3%), respectively. The item is used at school, it was concluded. Internet use for educational purposes is common among students at school ($M = 1.57$), never (57.1%), rarely (28.6%),

and sometimes (14.3%), and frequently (0.0%) use the details mentioned. It has been determined that the item is not used in the teaching of mathematics. I am aware that technology can assist me in understanding many mathematical concepts ($M = 4.29$), Never use what is mentioned (0.0%), rarely use what is mentioned (0.0%), irregularly use it (7.1%), often use it (57.1%), and usually use it (35.7%). It is recognized that the item is utilized in the teaching of mathematics. Therefore, the results support Aggarwal and Gupta (2020) suggestion that using technology improves and relaxes new life in the classroom. The outcomes also support the conclusions made by Abdi *et al.* (2021) Information communication and technology is a common term for information technology used for information processing, manipulation, and communication.

Table 3. The Use of Smartphones as ICT Facilities to teach Mathematics

Use of smartphones	1	2	3	4	5	Mean	Analysis
I use my smartphone to access any math-related internet resources.	0.0%	0.0%	0.0%	7.1%	92.9%	4.93	Used
I use the smartphone to support mathematics teaching due to its storage.	0.0%	7.1%	28.6%	42.9%	21.4%	4.79	Used
Average mean						4.86	Used

From Table 3, I use my smartphone to access any math-related internet resources ($M = 4.93$), Not (0.0%), rarely (0.0%), sometimes (0.0%), often (7.1%) and usually (92.9%) use what is mentioned. It's put in place that the mentioned item is utilized to teach mathematics. I use the smartphone to support mathematics teaching due to its storage ($M = 4.79$), Not (0.0%), rarely (7.1%), sometimes (28.6%), often (42.9%), and usually (21.4%). It has been confirmed that the discussed item is utilized in teaching mathematics. The outcomes are in line with Aggarwal and Gupta (2020) findings that the world is now easily accessible thanks to electronic devices.

Table 4. The Use of Computers as ICT Facilities to teach Mathematics

Use of computers	1	2	3	4	5	Mean	Analysis
For my classroom presentation, I'm using PowerPoint.	0.0%	14.3%	64.3%	21.4%	0.0%	3.07	Neutral
I use laptops to teach mathematics in the classroom.	0.0%	21.4%	64.3%	14.3%	0.0%	2.93	Neutral
I create a handout for my students.	0.0%	7.1%	85.7%	7.1%	0.0%	3.00	Neutral
I use a computer to process all of the information about pedagogical materials.	0.0%	0.0%	14.3%	57.1%	28.6%	4.14	Used
I connect a computer to a projector to use them as teaching tools.	0.0%	0.0%	14.3%	85.7%	0.0%	3.86	Used
Average mean						3.40	Neutral

Using Table 4, for my classroom presentation, I'm using PowerPoint ($M = 3.07$), Never (0.0%), rarely (14.3%), sometimes (64.3%), often (21.4%), and usual (0.0%). It has been outlined that the mentioned item is neutral in teaching mathematics. I use laptops to teach mathematics in the classroom ($M = 2.93$), Not (0.0%), rarely (21.4%), sometimes (64.3%), regularly (14.3%), or usually (0.0%). It has been put in place that the identified item is neutral in the teaching of mathematics. I create a handout for my students ($M = 3.00$), Never (0.0%), rarely (7.1%), sometimes (85.7%), frequently (7.1%), or always (0.0%).

The item in issue is neutral in the teaching of mathematics, it has been noted. I use a computer to process all of the information about pedagogical materials ($M = 4.14$), not (0.0%) at all, rarely (0.0%) at times (14.3%), frequently (57.1%), and almost always (28.6%). The use of the mentioned item in teaching mathematics has been put in place as used. I connect a computer to a projector to use them as teaching tools ($M = 3.86$), never (0.0%), rarely (0.0%), sometimes (14.3%), frequently (85.7%), or usually (0.0%). It has recently been supported that the mentioned item is used in teaching mathematics. The outcomes are in line with Joshi (2017) findings enhance learning motivation, problem-solving skills, performance, achievement, and self-learning capacity. They also support mathematical understanding, enjoyable learning, and engagement with mathematical concepts. ICT facilities help teachers develop their teaching, communication, adjustment, and other related skills as well as their permuted pedagogical skills, teaching effectiveness, professional skills, content knowledge, and teaching skills. The findings are also consistent with Walsh and Anderson (2009) ICT refers to the technology used to electronically exchange, manipulate, store, and share information in digital form. Computers, calculators, mobile devices, digital TVs, satellites, network infrastructure, e-mail, and robotics are just a few examples. Mathematics performance will be improved by any classroom teacher who has adequate and competent ICT skills.

Table 5. Other ICT Facilities used to teach Mathematics

Other ICT facilities	1	2	3	4	5	Mean	Analysis
I make copies of teaching materials with a photocopier.	0.0%	64.3%	35.7%	0.0%	0.0%	2.36	Unused
I'm utilizing a projector to deliver my lesson.	71.4%	21.4%	7.1%	0.0%	0.0%	1.36	Unused
I am competent at instructing students in mathematics using software.	78.6%	21.4%	0.0%	0.0%	0.0%	1.21	Unused
Average mean						1.64	Unused

From Table 5, I make copies of teaching materials with a photocopier ($M = 2.36$), not (0.0%), rarely (0.0%), sometimes (64.3%), often (35.7%), or always (0.0%). It has been determined that the mentioned item is not used in mathematics teaching. I'm utilizing a projector to deliver my lesson ($M = 1.36$), not (71.4%), rarely (21.4%), sometimes (7.1%), often (0.0%), or always (0.0%). It has been shown that the issue item is not used in mathematics teaching. I am competent at instructing students in mathematics using software ($M = 1.21$), never (78.6%), rarely (21.4%), irregularly (0.0%), frequently (0.0%), or usually (0.0%). It has been determined that the mentioned item is not used in teaching mathematics. The outcomes are in line with Essuman *et al.* (2022) for supporting the

teaching and learning of mathematics. In sum, the majority of the responses from the mathematics teachers to the items were similar and closely concentrated around the overall mean score of 3.68. The findings suggested that mathematics teachers in selected secondary schools use ICT facilities for teaching mathematics. Nevertheless, this goes in line with Aggarwal and Gupta (2020) research, which shows that ICT enhances mathematics education and helps learners understand key ideas. The research of Aggarwal and Gupta (2020) found that the internet and technological tools had made the whole globe accessible, was corroborated by several of these results. Additionally, to ensure achievement efficiently, teachers increasingly frequently use the Internet, computers, projectors, and other technological devices.

Conclusion

The usage of technology integration in mathematics education is a factor that affects how much teachers are likely to include technology into their teaching schedules. ICT facilities are being utilized by teachers to teach mathematics, according to the findings of this study. It was decided that, in order to give all mathematics teachers a chance to gain confidence in the use of technology in teaching, particularly mathematics, it is necessary to go back to the technology integration training in their preparation for teaching.

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