Mathematics in the Classroom: A Survey of Teachers' Opinions on the Use of Information and Communication Technologies (ICTs) in Teaching and Learning

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Original Research Article

Abstract

Aim: The purpose of this study was to look into how school mathematics teachers use ICT in their classrooms, as well as the perceived barriers and challenges to ICT integration in mathematics classrooms.

Study Design: The research was conducted using a descriptive cross-sectional survey research approach.

Methodology: A cluster sampling strategy was utilized to pick 120 teachers from public schools in the keta municipality of the Volta region for this study. The questionnaire was returned by 105 teachers, with an 87.5 percent response rate, and descriptive statistics were utilized to analyze the data. 72 percent of the 105 teachers were males and 28 percent were females.

Results: According to the findings, mathematics teachers use ICT in their classrooms to a very limited extent. Some mathematics teachers, on the other hand, frequently utilise ICT for common computer applications, including obtaining information on the internet for teaching, networking with colleagues and students, sending emails, and producing lesson notes etc. Respondents lacked proper training and access to instructional technologies, according to the findings.

The lack of printers and presentation equipment in schools, according to respondents, may hinder their ability to integrate ICT into the teaching and learning process.

Conclusions: Because of a lack of technical know-how and inadequate ICT tools, most mathematics teachers do not use ICT in their classroom. Teachers who have minimal experience with ICT, on the other hand, prefer to utilise it for non-teaching purposes.

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1 Introduction

According to current trends in information and communication technology, the world has become a global village. The importance of ICT in people's lives, especially students' lives, cannot be overstated. This is because ICT allows for quick and easy access to a vast amount of information all around the world. Indeed, a world without information technology is becoming increasingly difficult to envision, and Ghana is no different. Recognizing that the world has evolved into a global village, with all aspects of human life depending on computers and advanced communication systems to function, it has become critical for our teachers to learn how to acquire ICT skills in order to be effective teachers [1] because there is a belief that ICT may significantly improve teaching and learning [2].

As a result, Ghana's new educational reforms, which began in June 2007, prioritised the integration of ICT tools across all subject areas, with a particular emphasis on ICT as a tool for teaching mathematics. The senior high school mathematics curriculum, for example, emphasises the use of spreadsheets to create graphs and calculate mean, mode, median, and standard deviation, as well as the calculator and computer for problem solving and investigating real-life problems [3].

Ghana's government recognises the importance of mathematics instructors to be supported in a variety of ways. As stated in the Ghana Information and Communication Technology for Accelerated Development [4], he views ICT literacy as an engine for accelerated development. Ghana's educational system is expected to improve through the use of ICT to: (i) improve and expand access to educational training and research resources; (ii) improve the educational quality and training; and (iii) make the educational system responsive to suit the economy's and society's demands and requirements , with particular reference to the development of the information and knowledge-based economy and society [5].Technology has a vital role in teaching and learning mathematics, according to extensive research investigations. Yidana [6] claims, for example, that technology improves the way mathematics is taught and enhance students' knowledge of fundamental concepts. As a result, the government has made a significant effort to incorporate ICT into teacher education as well. Furthermore, the University of Education, Winneba (UEW) and the University of Cape Coast (UCC), Ghana's two teacher training universities, have invested heavily in technological facilities and infrastructure over the years to increase student and lecturer access to ICT facilities and equipment for effective ICT instruction [7]. There is universal consensus that teachers' ICT knowledge and abilities are important [8]. As a result, the government and other organisations have made huge financial investments in the purchase of computers and the establishment of computer laboratories in the majority of junior and senior high schools. However, whether or not these computers are being put to good use by instructors in their everyday class delivery is still unknown. This raises question of whether or not mathematics teachers require any additional support in order to effectively integrate ICT into their regular teaching schedules. As a result, it was critical to undertake an empirical study to evaluate mathematics teachers' perspectives on ICT integration methods in the Ghanaian educational system.

1.1 Purpose of the Study

The goal of the study was to learn more about mathematics instructors' perspectives on the use of ICT in mathematics teaching and learning in a few Ghanaian junior and senior high schools.

1.2 Research Questions

The study was guided by the following research questions:

1. To what extent do mathematics teachers use ICT in their classrooms?
2. What, in the opinion of mathematics teachers, are the barriers and challenges to ICT integration in the mathematics classroom?

2 Literature Review

The following headings were used to arrange the literature review for this study:

(a) The use of ICT in mathematics teaching and learning
(b) ICT abilities in mathematics teaching and learning
(c) The impact of ICT on mathematics teaching and learning
(d) Perceptions of the value of ICT in mathematics classrooms.
(e) ICT integration challenges in mathematics classrooms

2.1 The use of ICT in mathematics teaching and learning

The incorporation of Information and Communications Technologies (ICT) into professional practise places significant pressures and demands on teachers to provide students with opportunities to develop the skills needed to participate in a progressive society and become life-long learners [9], as well as to enhance current curriculum content learning. Educators must incorporate new technology into their teaching practise to fully leverage the potential of ICT, resulting in enhanced student outcomes [10].

According to Reynolds (2001), schools are adopting ICT as a supplement to classroom activities by accessing existing information and expertise, rather than as an inherent element of educational practice. Ward [11] indicates, teachers must learn how to use ICT to extend students' thinking and problem-solving skills rather than just as a tool for publishing and research. According to Hook [12], incorporating ICT into mathematics teaching and learning allows students to conjecture and test the validity of their conjectures, prove and persuade others that their conjectures are correct, and critique or disprove conjectures, thereby improving students' problem-solving and critical thinking skills. The primary benefits of Mathematical instruction using ICT, according to Becta [13], are as follows: (i) Information and communication technology (ICT) supports student collaboration and knowledge sharing. (ii) ICT provides pupils with timely and precise feedback, which helps with positive motivation.

There are other motivations to use ICT into mathematics instruction. According to Keong, Horan, and Danie [14], using ICT in mathematics instruction can improve both the effectiveness of the teaching process and the students' ability to grasp basic concepts. Electronic technologies, according to the National Council of Teachers of Mathematics, provide visual representations of mathematical principles, assist in data organisation and analysis, and compute quickly and accurately. Technology can help students explore all areas of mathematics by allowing them to focus on decision-making, reflection, reasoning, and problem-solving NCTM [15].

According to research, using ICT to teach and learn mathematics improves students' mastery and enjoyment of the subject at all levels. Wall, Higgins, and Smith [16], recommend that using interactive white boards (IWB) for teaching and learning mathematics aids student understanding, focus, easy remembering, and thinking process when they utilise IWB to display information and mathematics games. Clements and McMillen [17] suggest that students' use of computer programmes in mathematics instruction facilitated conversation, problem solving, and the development of conceptual understanding.

2.2 ICT abilities in mathematics teaching and learning

Teachers will need more knowledge and abilities to use technology to aid student learning, which will need examination of the relationships between technology, content, and pedagogy. To put it another way, technology integration necessitates that pre-service and in-service teachers comprehend: (a) the technology tools themselves, as well as (b) the specific affordances of each tool that, when used to teach content, make difficult concepts easier to grasp, resulting in meaningful student learning outcomes [18]. Teachers must increase their knowledge of pedagogical approaches across numerous parts of the planning, implementation, and evaluation processes when teaching with technology. When using technology as a teaching tool, for example, teachers must be able to: develop plans for teaching software to students; select appropriate computer applications to meet the curriculum's instructional needs as well as their students' learning needs; and manage computer hardware and software [19].

2.3 The impact of ICT on mathematics teaching and learning

Understanding what students know and need to learn, as well as challenging and encouraging them to acquire it successfully, is essential for effective mathematics instruction [15]. Furthermore, children must acquire mathematics while actively building new ideas from existing knowledge and experience. As a result, teachers must try to make mathematics simple enough for students to grasp the many topics taught. ICTs also have a lot of potential for spreading knowledge, improving learning, and developing more efficient educational services. Moreover, the adoption of ICT by education has been seen as a powerful way to contribute to educational change, better prepare students for the information age, improve learning outcomes and competencies of learners, as well as providing students with information for survival in the society. As a result, teachers must include technology into their teaching and learning processes. In this fast moving and technologically reliant society, students are now faced with the need for a solid understanding of mathematical skills and concepts. Research indicates that technology plays essential role in the teaching and learning of mathematics as It has an impact on how mathematics is taught and improves students' learning [15]. Technology influences the skills taught and improves student learning and should therefore be used to support the learning of mathematics. In so doing, [15] advises that technology should be integrated into the mathematics curriculum rather than being offered as a supplement.

2.4 Perceptions of the value of ICT in mathematics classrooms

Teachers' attitudes about mathematics learning with or without technology are regarded significant in mathematics education because it has great impact on teaching and learning, as well as curriculum revision. Despite the obvious benefits of using ICT for educational purposes, research reveal that many teachers who are ICT literate do not use it in their classrooms, limiting the learning potential of ICT [20]. According to Barak [21], teachers overuse ICT for personal learning, but they are hesitant to incorporate current technologies into their teaching. While teachers see the potential of technology to promote students' learning and make school subjects more relevant to real-life situations, they do not believe that ICT is superior for classroom instruction or fostering cooperation and reflection in learning.

2.5 ICT integration challenges in mathematics teaching and learning

Teacher understanding of ICTs is a key element deciding whether or not instructors utilise ICTs in their classrooms and how they use ICTs to promote learning, according to recent literature on the usage and implementation of ICTs in classrooms [22]. Jones [23] identified seven challenges to integrating ICT into mathematics lessons. These barriers included; (i) instructors' lack of confidence during integration, (ii) insufficient access to resources, (iii) a lack of integration time, (iv) a scarcity of good instruction, (v) technical difficulties encountered while utilising the software, (vi) a lack of personal access while preparing lessons, and (vii) age of the teachers.

These findings support the findings of a study by [14], which found six key hurdles to ICT integration in the mathematics classroom for some instructors. Lack of time in the school schedule for ICT projects, insufficient teacher training opportunities for ICT projects, insufficient technical support for ICT projects, lack of knowledge about how to integrate ICT to enhance the curriculum, integrating and using different ICT tools in a single lesson, and lack of access to the necessary technology at students' homes were among the barriers.

Concerns of the teacher, lack of skills and expertise and belief systems in pedagogy are three impediments to integrating ICT in mathematics instruction, according to Saye [24].

Some of the issues in integrating ICT in the instructional process, according to Raju [25], include:

    a.   Lack of ICT skills among teachers: Lack of ICT skills among teachers is a problem for the use of ICT in education. First and foremost, teachers in institutions where ICT will be employed in education must be well trained in ICT tools in education. Teachers must understand how and when to use ICT technologies to achieve certain goals before teaching pupils.

b. Resistance to change: Managing change is one of the most difficult challenges, as teachers are resistant to change. At general, many teachers in educational institutions lack ICT skills and are resistant to change.

c. Leadership issue: Integrating ICT into education is a difficult endeavour that necessitates a wide spectrum of administrative support. As a result, adequate persuasion is required to get their support. Leadership is required before, during, and after the deployment of ICT in education.

In Ghana, the hurdles of integrating ICT into mathematics instruction are tremendous. However, a study conducted by Malcolm and Godwyll [26] in four Ghanaian schools to determine the diffusion of ICT in Ghana found that, in addition to being underpaid, overworked, or struggling in under-resourced environments, some mathematics teachers frequently face opposition to changes in classroom practise from fellow teachers, school administrators, and parents, but they manage to find the extra time and energy required to integrate ICTs in schools.

3 Methodology

A cross-sectional survey research design was used in this study. According to Muijs [27], a cross-sectional survey entails gathering information from a sample taken from a preset population at a single point in time via a questionnaire or the ability to test individuals to discover certain group characteristics.

The questionnaire was the primary tool utilised, and it was self-administered and consisted of closed ended and rating scale items. According to Boakye and Banini [28], respondents find likert scales appealing, and they frequently enjoy filling them out.

The questionnaire was divided into three (3) sections (A-C).

Part (A) comprised six (6) items that asked for demographic information from respondents, gender, age, highest qualification, teaching experience, computer experience, and computer usage were among the factors in section (A).

The second section (B) consisted of six (6) items (i.e. 25–30) that asked for information on respondents' usage of ICT in mathematics teaching and learning, with a grading scale of: Almost always (3), often (2), frequently (1), never (0).

The final section (C) consisted of fourteen (14) items (i.e. 31-44), which sought information on respondents' opinion of Barriers and Challenges in ICT integration in mathematics teaching and learning, using a rating scale of Strongly Agree (SA = 5), Agree (A = 4), Neutral (N = 3), Disagree (D = 2), and Strongly Disagree (SD = 1).

All public senior and junior high school mathematics teachers in Ghana's Volta area made up the study's population. One hundred and twenty (120) teachers from junior and senior high schools in the Volta region's Keta municipality were selected using a cluster sampling technique. Cluster sampling, according to Fraenkel and Wallen [29], is a form of sample procedure in which the researcher splits the population into clusters. One hundred and five (105) teachers returned the questionnaire out of the one hundred and twenty (120) teachers who were chosen. The response rate was 87.5 percent, which is statistically acceptable for descriptive statistics-based analyses [8].

4 Data Presentation and Analysis

4.1 Research question one

To what extent do mathematics teachers use ICT in their classrooms?

Majority of the respondents (76%, n = 79) indicated that they never use ICT in giving class instruction, 79% (n = 83) indicated that they never use ICT in communicating with students, 79% (n = 83) indicated they never use ICT in organizing class discussions, demonstrations and presentations, 76% (n = 79) of the respondents

indicated they never use ICT to assess students learning through test, 87% (n = 91) of the respondents indicated they never use ICT in sending feedback to students and 86% (n = 91) of the respondents indicated they never use ICT in supporting collaboration among students. According to the findings, most mathematics teachers do not use ICT in their classrooms.

Table 1. Indicates how mathematics teachers' rate their frequency of technology use in their classrooms

Item	All most always N (%)	Frequently N (%)	Often N (%)	Never N (%)	Total
25. I use ICT in giving class instruction	8 (8)	18 (17)	11(11)	68 (65)	105
26. I use ICT in communicating with students	8 (8)	14 (13)	18(17)	65 (62)	105
27. I use ICT in organizing class discussions, demonstrations and presentations	0 (0)	22 (21)	14(13)	69 (66)	105
28. I use ICT in assessing students learning through test	14(13)	12 (11)	11(11)	68 (65)	105
29. I use ICT in sending feedback to students	6 (6)	8 (8)	17(16)	74 (71)	105
30. I use ICT in supporting collaboration among students	0 (0)	14 (13)	15(14)	76 (72)	105

4.2 Research question two

What, in the opinion of mathematics teachers, are the barriers and challenges to ICT integration in the teaching and learning of mathematics?

Table 2. Teachers' perception of barriers and challenges in ICT integration in teaching and learning of mathematics

Item	SA N (%)	A N (%)	N N (%)	D N (%)	SD N (%)	Total
31. I have adequate training and access to instructional technology	14 (13)	52 (50)	20 (19)	8 (8)	11 (11)	105
32. Using technology for instruction is cheap in Ghana	6 (6)	10 (10)	4 (31)	31 (30)	25 (24)	105
33. There are training opportunities for teachers on the field to acquire new computer knowledge or skills	8 (8)	54 (51)	19 (18)	8 (8)	16 (15)	105
34. I own a computer that I use for teaching	18 (17)	17 (16)	7(7)	38 (36)	25 (24)	105
35. My school has a computer laboratory	47 (45)	30 (29)	4 (4)	14 (13)	10 (10)	105
36. I have access to my school's computer laboratory	27 (26)	28 (27)	9 (9)	27 (26)	14 (13)	105
37. There are sufficient computers in computer laboratories	14 (13)	26 (25)	6(6)	31 (30)	28 (27)	105
38. There sufficient presentation equipment	8 (8)	19 (18)	7(7)	40 (38)	31 (30)	105
39. There are sufficient input devices in computer laboratories	4 (4)	5 (25)	5 (5)	40 (38)	30 (29)	105
40. There are sufficient output devices	0 (0)	25 (24)	9 (9)	43 (41)	28 (27)	105
41. There is frequent technical support in my school	0 (0)	21(20)	17 (16)	28 (27)	39 (37)	105
42. In my institution, there is enough	0 (0)	22(21)	20 (19)	36 (34)	27 (26)	105

Item	SA N (%)	A N (%)	N N (%)	D N (%)	SD N (%)	Total
time to design computer-based instructional resources.						
43. My computer abilities will aid me in implementing instructional technology.	14 (13)	55 (52)	11 (11)	7 (7)	18 (17)	105
44. In my school, ICT integration professional development courses are held on a regular basis.	0 (0)	26 (25)	9 (9)	20 (19)	50 (48)	105

Out of 105 respondents 63% (n=66) of them generally agreed that they have adequate training and access to instructional technology, (53%, n=56) of the respondents generally disagreed that using technology for instruction is cheap in Ghana, (59%, n=62)) of the respondents generally agreed that there are training opportunities for teachers on the field to acquire new computer knowledge or skills, 60% (n= 63) of the respondents generally disagreed that they have personal a computer they use for teaching, (73%, n=77) of the respondents generally agreed that their school has a computer laboratory, (52%, n=55) of the respondents generally agreed that they have access to their school's computer laboratory, 56% (n=59) out of the 105 respondents generally disagreed that there are sufficient computers in computer laboratories, 68% (n=71) generally disagreed that there are sufficient presentation equipment, 67% (n=70) generally disagreed that there are sufficient input devices, (68%, n=71) of the respondents generally disagreed that there are sufficient output devices, 64% (n= 67) of the respondents perceived that there is no frequent technical support in their schools, (60%, n= 63) most of the respondents perceived that there is no sufficient time to create computer-based instructional materials for their school , respondents agreed (66%, n=69)) that their expertise in computer skills will help them in using instructional technology and (67%, n= 70) of the respondents perceived that there are no frequent professional development courses relating to the incorporation of ICT in their schools.

5 Discussion

The findings revealed that mathematics teachers use ICT in their classrooms to a relatively limited extent. Mathematics teachers, on the other hand, frequently utilise ICT for ordinary computer applications including obtaining information on the internet for teaching, networking with colleagues and students, sending emails, and generating lecture notes, among other things. This finding is in line with the findings of [30], who found that while the majority of SHS teachers in Ghana do not use ICT in the classroom, they frequently use technology to prepare lesson notes, access the web, and send emails.

Similar research conducted in other nations back up the findings. For example, [31] found that, despite teachers' enthusiasm and eagerness to learn about the potential of ICT, in practise, technology use is moderately low and focused on a small number of apps, with word processing being the most common. Furthermore, according to a study conducted by [32] to investigate the level of ICT use in instruction, only a small percentage of teachers are serious computer users in the classroom.

Again, it was revealed that:

- Respondents saw that they do not have adequate training and access to instructional technology
- The lack of printers and presentation equipment in schools, according to respondents, may hinder their ability to integrate ICT into the teaching and learning process.
- Respondents perceived that, there are insufficient computers in computer laboratories
- Training of Mathematics teachers regularly can help them to use ICT in instructing Mathematics [23].

Other studies have found that lack of teacher training, particularly in the use of mathematics software, lack of ICT resources in schools, insufficient time to integrate ICT due to overloaded mathematics syllabus, and lack of knowledge and skills required by teachers to integrate ICT in the teaching and learning process are some of the problems in integrating ICT in mathematics teaching and learning, for example, [23,22]; Conversely, [33]

suggests a variety of variables that may improve the usage of computers in the classroom. These include: (i) scheduling time for students to utilise computers as part of class tasks, (ii) having easy access to ICT equipment and infrastructure, and (iii) teachers' personal views that encourage a student-centered, Pedagogy based on constructivism

6 Conclusion and Recommendations

According to the study's findings, most mathematics teachers do not use ICT in their classrooms due to a lack of technical knowledge and inadequate ICT instruments. Teachers who are a little familiar with ICT, on the other hand, prefer to use it for non-educational purposes. As a result, the study suggests the following decisions or actions:

1. The Ghana Education Service's Curriculum Research Development Division (CRDD), in collaboration with related Ministry of Education agencies, should undertake research and amend the present syllabus to specifically define what ICT tools must be used and how they should be used in the teaching and learning process.
2. In collaboration with some NGOs the district or regional education service can donate computers to less equipped schools and also as a way of motivation, teachers can be given laptops in a form of loan packages.
3. To foster the use of ICT in the teaching and learning of mathematics, the heads of institutions, in partnership with the heads of departments, should highlight the use of computer laboratories by each teacher at least once a week at both the J.H.S. and S.H.S. levels.

Disclaimer

The products used for this research are commonly and predominantly used products in our area of research and country. There is absolutely no conflict of interest between the author and the producers of the products because the author does not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was funded by the personal effort of the author.

Competing Interests

The author has declared that no competing interests exist.

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