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Exploring the ICT Software for Teaching Mathematics at the Secondary Schools in Nigeria and South Africa

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Abstract: *The study explored the Information and Communication Technology (ICT) software for teaching mathematics at the secondary schools in Nigeria and South Africa. The study adopted descriptive survey design. The population of the study is targeted at senior secondary schools teachers in Nigeria and South Africa. The sample of the poll comprised 120 teachers teaching in Nigerian and South African senior secondary schools. Purposive sample was deployed to choose the sample for the investigation. 120 teachers from schools within the Bojanala District in Rustenburg and Delta North Senatorial District were selected. A questionnaire was used to assemble the data. The instrument's face validity was established by the opinions of three experts. The instrument's reliability was determined using Cronbach Alpha which yielded a reliability coefficient of 0.80. The information gathered was evaluated with computed mean statistics. According to the result of the investigation, Geogebra, maple, excel and word processing software are the widely used ICT softwares to teach mathematics in Nigerian and South African high schools, and ICT software impact students' learning positively. The study found that pupils benefit from using Geogebra more than any other tools in South Africa than in Nigeria where the students prefer to use excel.*

Keyswords: ICT, Software, Mathematics, Teaching, Achievement,

Background to the Study

Mathematics is the investigation of numerals, quantities, and spatial relationships with the goal of solving human problems. Mathematics is a rational science that aims to comprehend, explain, and even control the world around us. Mathematics is among the most important courses for raising individual awareness of how to contribute more effectively and meaningfully to nation building. It prepares students for careers in medical, engineering, computer science, and other fields. Mathematics is an inextricably linked component of science. In Nigerian high grades, this is an obligatory subject.

Mathematics' significance cannot be overstated and underestimated in human endeavours. Mathematics plays four important roles in four aspects. They are: mathematics as a key for economic prosperity, a core skill in life, full of beauty, and mathematics education (Anibueze, 2015). Mathematics achievement is known to be the pillar of a prospering society owing to the critical, analytical and problem-solving skills that it imparts on those who have studied it (Fatima, 2013; Suratno, 2016). Within the global community, mathematics is among the subjects that determines the health of a country's education system (Reddy, Zuze, Visser, Winnaar, Juan, Prinsloo, Arends & Rogers, 2015). Mathematics is also known to enhance people's everyday lives and consequently, individuals who have difficulties with mathematics are usually disadvantaged in the large-scale economic upsurge of any country. The success of a country's economy is linked to its success rate in mathematics.

In acknowledgement of the value of mathematics, the Federal Republic of Nigeria (FRN) (2013) and National Development Plan (2012) of the South African government stipulates that mathematics education is a priority in Nigeria and South Africa. Hence, the plan includes increasing the student population that are eligible to study science and maths degrees at the universities. The present era requires mathematics knowledge that includes electronic technology in various contexts. The modern-day society uses technology in various aspects of existence and, therefore, it ought to be common practice to employ technology as among the instruments for addressing issues with arithmetic performance.

Educational technologies are those tools, machines, devices, ideas, procedures, organization, e-books and so forth, which make teaching and learning process more effective, successful and interesting. They contribute fundamental and effective role in pedagogy of science-related subjects. Based on Henessy (2006), the significance of technology for teaching of science disciplines in schools is inevitable to ignore because, the deployment of technology aids in the teaching of science by facilitating discovery, supporting collaborative knowledge, enhancing motivation and commitment, giving students more responsibility and control via independent exploration and discovery, and helping them to more clearly understand how processes work. Various studies such as Leendertz, Blignaut, Blignaut, Els & Ellis (2013) and Makotjo (2020) indicated that a concentration on employing technology as a component for teaching and learning will provide the answer to the quests for effective mathematicss instruction and learning in our secondary schools. It has been demonstrated that the technological deployment in a mathematics classroom enhances teacher-student engagement, resulting in improved focus, motivation, and attention, in addition greater success and performance in the subject (Lan, 2018).

The Nigerian and South African governments also recommend that quality technological software should be employed in the classroom setting to enhance both instructors' and participants' learning. This encapsulates the belief in the incorporation of

technology as a means of improving mathematics instruction (FRN, 2013; National Development Plan, 2012). Leendertz et al. (2013) assert that the application of appropriate ICT software during technology integration is recognized to provide productive educational activities. It is for this reason that this study focus on exploring the ICT software for secondary school mathematics teaching in Nigeria and South Africa.

ICT software for teaching mathematics: Empirical Studies

Howie and Blignaut (2009) appraised South Africa's capacity to implement ICT in scientific and mathematics classrooms. This was accomplished by contrasting a range of "permanent transformation" metrics from SITES 2006 with countries like Chile, Thailand, and Norway—the latter of which had significantly different context and conditions than the first two. The results demonstrate that while ICT integration into education has advanced significantly in South Africa since 1998, the majority of schools are still in the early stages of ICT acquisition, and the vast majority of those who do have access are making an effort (Mokotjo, 2020). It appears that more fundamental demands have taken precedence over other objectives in South Africa's educational system.

In the Vhembe East District of the Limpopo Province of South Africa, Netsianda and Ramaila (2021) examined how ICT is deployed in high grade mathematics instruction and learning. The study used a combined an exploratory with descriptive survey research design employing a mixed - method approach, with 60 mathematicss instructors from high grades in the Vhembe East District participating. Numerical information was gathered via the deployment of a survey questionnaire. To give elaboration on tendencies that arose from quantitative data, qualitative data was obtained through classroom observations. The fundamental theoretical framework for the study is the Technology Acceptance and Use: A Unified Theory (UTAUT). The universal deployment of technology in mathematics instruction and learning demonstrates a glaring lack of technical proficiency on the part of mathematics teachers. Effective Technology integrating in mathematics instruction was hampered by several problems, including insufficient bandwidth and inadequate specialized training when employing digital media. Although embracing digital technology into mathematics teaching generated an interesting setting for learning, it was still challenging to develop products that showed better levels of knowledge of how to use the technology for teaching. Teachers lamented the school's lack of crucial help in administration in addition to insufficient professional training on ICT using it within the study and teaching of mathematics.

Contrasting the performance of two groups, a treatment group and an intervention class-was used to appraise the performance of 31 schools in the EMDC East education district of Cape Town, South Africa. The intervention class (14 high schools) has had computer access since 2001, while the regulated schools only acquired them between early 2006 and early 2007. Alternatively, against the control schools, the experimental schools are probably more computer-oriented. The observations suggest, there was no discernible difference in the concluded Senior Certificate mathematics results between schools either with or without computers, no discernible change in the outcomes after the computer laboratories were mounted, no perceptible transformation in the percentage of students who passed Executive Certificate Mathematics, and no perceptible transformation in the student enrolment for Higher Grade Mathematics. This conclusion emphasizes the call for prudence when implementing ICTs in the classroom as a potential solution to the dilemma of mathematics failure in our culture.

Williams, Charles-Ogan and Adesope (2017) studied Students' interest in and proficiency with mathematics in high grade three (SSS3) after using interactive geometry software. In a four-week study, the researchers deployed a descriptive survey methodology and quasi-experimental designs with a sampling size of sixty (60) SSS3 students. A questionnaire titled "Students' Interest on Geogebra (SIG)" and an achievement test were accustomed to obtain information. Geometry lessons were given to the Experimental Group (EG), but none were given to the Control Group (CG). A study topic and a hypothesis acted as the guide for the investigation. The mean was engaged to provide remedies to the study's questions, and a t-test on an independent sample was deployed to appraise the theory. A mean result of 2.85 over the criterion mean of 2.50 demonstrates that the program increases pupils' interest in mathematics. The zero likelihood (H0) was rejected as the t-cal (3.394) > t –critical was indicated by the post-test result, which showed that the EG and CG had values of (62.20, 2.52) and (61.34, 2.61), respectively. A major proposal based on this idea was that lecturers should always incorporate applications that foster learning as conflicting to merely speaking about the fusion of technologies.

Statement of the Problem

The performance of Nigerian and South African learners in mathematics is causing increasing worry. From the perspective of the Global Competitiveness Report (2013), mathematics learning is in crisis in Nigeria and South Africa. Similar to Reddy and Janse van Rensburg (2011), Nigerian and South African senior school mathematics performance is among the worst in the world. In a normal Nigerian or South African senior school, math proficiency ranges from 30 to 40% per grade. The Center for Development and Enterprise suggests that 90% of Nigerian and South African high school graduates do not satisfy the basic performance levels expected by postsecondary schools (Spaull, 2013). Also, there is concern that students would enter postsecondary institutions with weak mathematics skills, leading to a decrease in studying mathematics-related courses.

The use of ICT software in mathematics instruction has been recommended resulting from a boost in worry about mathematics performance generally and particularly bad performance in high school mathematics. Generally, technology is amongst the most crucial educational instruments for enhancing mathematics student learning. (Azlim, Amran & Rusli, 2015). Consequently, the study's goal is to ascertain the ICT software utilized in the instruction of maths in Nigerian and South African senior secondary schools, as well as the ICT software's benefits to students.

Research Questions

This study was guided by the following specific questions:

1. What ICT software is use to teach mathematics in Nigerian senior secondary schools?
2. What ICT software is used to teach mathematics in South African high schools?
3. Do students gain from the usage of ICT software in mathematics teaching?

Purpose of the Study

The study looked into the application of ICT software in high schools mathematics in Nigeria and South Africa to teach mathematics. The investigation's goal was to explore: 1. ICT softwares utilised to teach mathematics in high grades in Nigeria;

2. ICT softwares utilised to mathematics in high schools in South Africa; and
3. Whether students benefit from the use of ICT softwares in mathematics classes.

Significance of the study

Teachers, students, and the Department of Education (DoE) and other stakeholders will benefit from the study's conclusions. Teachers will receive insight and understanding on the ICT software used in mathematics classrooms, in addition to the amount to which these ICT softwares boost mathematics learning. The visual aids supplied by ICT software will provide learners a perspective on the mathematics topics where ICT can be used. They will also obtain a thorough comprehension of mathematics and a positive attitude toward mathematics as a school subject. The Department of Education and its stakeholders will be given information on what they can do to better equip their training to improve the standard of instruction practices in high schools by incorporating ICT software into mathematics instruction.

Dimensions and Limitations of the study

The study examined how high schools in South Africa and Nigeria were using ICT to teach mathematics. Only senior high school level mathematics instructors in South Africa and Nigeria who use ICT applications in their classes provided their feelings and ideas for the study, which was conducted.

Research Methodology

A descriptive methodology was deployed to execute the research. This methodology was found suitable since a questionnaire was used to elicit information from a representative sampled study's population. Senior grades instructors in Nigeria and South Africa are the study's intended audience. 120 mathematics instructors from high grades schools in South Africa and Nigeria actively participated in the study. The sampling for the inquiry was selected via purposeful sampling. 60 high grades mathematics instructors from the Bojanala District in Rustenburg and 60 instructors of mathematics in high grades from the Delta North Senatorial District were chosen. The instructors were chosen based on their experiences, accessibility to internet and computers, and previous deployment of ICT applications in the classroom. In this study, data was assembled via a questionnaire. The instrument's face validity was established by the opinions of three experts. The professionals evaluated the research instrument with a critical eye to fine-tune the instrument's face value and content to match the topic at hand. The instrument's reliability was determined using the Cronbach Alpha method, which provided a reliability coefficient of 0.80. Mean statistics were deployed to analyse the data, with a criterion mean of 2.50. A mean reaction of less than 2.50 indicates disagreement, where as a mean response of 2.50 or more indicates agreement.

Presentation of Results

This subsection reports the analysis of the inspected data provided in keeping with the study's research questions.

Research Question 1: What ICT software is use to teach mathematics in Nigerian senior secondary schools?

Table 1:
Frequency of Specific Technology Software use for Teaching Mathematics

Software	Mean	Remarks
Geogebra	3.97	**Agreed**
Mathematica	1.71	**Disagreed**
MATLAB or Maple	3.93	**Agreed**
Word processing software	2.94	**Agreed**
Excel software	3.12	**Agreed**
Google search engine	2.55	**Agreed**
Management programs	1.13	**Disagreed**
Weighted Mean	**2.76**	**Agreed**

Criterion mean = 2.50

The computed mean, 2.76, is greater than the criterion mean, 2.50, as made known in Table 1. This means that the respondents affirmed that the ICT software for teaching mathematics is Geogebra, maple, excel software, word processing software, and the Google search engine. As made known in Table 1, the most extensively utilized ICT softwares for teaching mathematics in Nigerian high grades are Geogebra (3.97), Maple (3.93), Excel software (3.12), and Word processing software (2.94).

Research Question 2:

What ICT software is used to teach mathematics in South African high schools?

Table 2:

Frequency of Specific Technology Software use for Instructing Mathematics

Software	Mean	Remarks
Geogebra	4.74	**Agreed**
mathematica	1.60	**Disagreed**
MATLAB or Maple	2.00	**Agreed**
Word processing software	3.24	**Agreed**
Excel software	3.80	**Agreed**
Google search engine	2.86	**Agreed**
Management programs	1.51	**Disagreed**
Weighted Mean	**2.82**	**Agreed**

Criterion mean = 2.50

The computed mean, 2.82, is more than the criterions mean, 2.50, as made known in Table 2. This means that the respondents affirmed that the best ICT software for teaching mathematics is Geogebra, Excel, Word processor, and the Google search engine. As made known in Table 1, the most extensively utilized ICT softwares for mathematics instruction in South African high grades are Geogebra (4.74), excel software (3.80), and word processing software (3.24).

Research Question 3: Do students gain from the deployment of ICT software in mathematics teaching?

Table 3:

Impact of Computer Usage on Students' Academic Attainment

ITEMS	MEAN	REMARK
ICT software help students with class assignment.	**3.13**	**Agreed**
ICT software helps students prepare for mathematics quizzes.	**3.17**	**Agreed**
ICT software fostered interaction and teamwork among students.	**2.81**	**Agreed**
ICT software increases students' interaction with course content.	**2.83**	**Agreed**
ICT software enhances students' performance scores	**3.32**	**Agreed**
ICT software increase students' motivation to learn.	**3.33**	**Agreed**
ICT software help students with expand accessibility to learning materials and educational resources.	**3.44**	**Agreed**
ICT software provides enhancement materials to supplement the textbook.	**3.16**	**Agreed**
ICT software enables students to accomplish learning tasks more quickly.	**3.17**	**Agreed**
ICT software games increase my creativity.	**2.82**	**Agreed**
GRAND MEAN	**3.12**	**Agreed**

Criterion mean = 2.50

The cumulative mean in Table 3 is 3.12, which is more than the criterion mean of 2.50. This implies that the overwhelming of those surveyed affirm that the deployment of ICT software has a beneficial impact on students. ICT software helps students with school assignments (3.13), preparation for science quizzes (3.17), interaction with course content (2.81), interaction among students (2.83), increase in performance scores (3.32), an eagerness to learn (3.33), easy accessibility to online materials (3.44), provision of enhanced materials to supplement textbooks (3.16), and encourage creativity, according to the respondents (2.82). Consequently, it is said that the use of ICT software benefit students in the following ways: ICT software assists students in school assignments, mathematics quiz preparation, interaction with course content, interaction among students, eagerness to learn, easy access to online materials, provision of enhanced materials to supplement textbooks, easy completion of learning tasks, and foster creativity during teaching and learning.

Discussion of Results

Geogebra, Maple, Excel, and Word processors are perhaps the most common extensively utilized ICT softwares for mathematics instruction in Nigerian and South African high grade schools, in line with the poll. This finding corroborated that of Netsianda and Ramaila (2021), who stated that word processor, Excel software, and the Google search engine were by far the commonly utilized software packages in the classroom among mathematics teachers. According to Netsianda and Ramaila (2021), social media platforms like WhatsApp and Facebook are also utilized for mathematics instruction.

Considering the respondents' remarks, the study revealed that using ICT software has a good impact on students achievements. Attributable to the respondents, adopting ICT software in the instruction in the school enhances students' learning in the following ways: solving class assignments, preparing for science quizzes, interaction with course content, edutainment purpose, motivation to learn, increased access to online materials, and enhancement provision. This finding is backed up by Akcay, Durmaz, Tuysuz, and Feyzioglu (2006) and Mokotjo (2020), who claim that ICT software technology improves students' attitudes and grades. They went on to posit that deploying computer multimedia applications for graphs and questions is more appealing than traditional education, particularly when animation and sound effects are included. The proper application of ICT software can help pupils improve their mathematics skills and overall achievements in mathematics.

Conclusion

Based on the findings of this study, Geogebra, maple, excel software, and word processor programs are the ICT software for mathematics instruction in Nigerian and South African high school grades. Solving class assignments, preparing for science tests, interacting with course content, edutainment purpose, encouragement to learn, increased accessibility to internet materials, and supply of augmentation are only a few examples of how ICT software assists students in teaching and learning.

Recommendations

Attributable to the study's findings, the following suggestions are made:

1. Adequate ICT software should be provided to schools by government and agencies such TETFund.
2. Mathematics instructors should use ICT software to supplement teaching.
3. ICT applications should be used to improve students' active engagement in the instruction and learning process.

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