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ICT UTILIZATION IN TEACHING-LEARNING OF MATHEMATICS: A CALL FOR PROPER INTEGRATION AND ENHANCING TEACHERS –STUDENTS' PERFORMANCE IN THE DEVELOPING COUNTRIES

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ABSTRACT

The study looked at the ICT utilization in teaching-learning of mathematics: a call for proper integration and enhancing teachers–students' performance in the developing countries. The importance of mathematics cannot be played down. Everyone uses it in their everyday activities. Mathematics has been seen as the basis for the economic, scientific and technological development of every nation. To sustain this importance, it becomes imperative to encourage students to study the subject and one way to do that is to effectively integrate the ICT into teaching the subject. The ICT is very essential in the study of mathematics because of its benefits. In integrating these ICT tools, there are problems encountered by the mathematics teachers which is require to be solved. The study reviewed the literature on the nature of mathematics, the vision of ICT, the nature of ICT, incorporation of ICT into teaching mathematics, problems of utilizing ICT in mathematics teaching-learning, the willingness of ICT use in Mathematics Education, ICT and its influence on mathematics teaching-learning, the benefits of applying ICT to Learning and Teaching Mathematics, Some ICT tools utilized for mathematics teaching, some recommendations were made by the researcher and forty-nine authors were reviewed to support the study.

Keywords: ICT utilization, teaching-learning, mathematics, developing countries

The nature of mathematics

Mathematics is one of the most vital core subjects made compulsory in Nigeria's educational system both at the primary and secondary school levels. Many countries made it compulsory because of its importance. It has to turn out to be part of our life and daily living. It has become an essential tool for the growth and progress of the whole nation today (Roohi, 2012, Onoshakpokaiye, 2021). Mathematics is a vital part of an individual's human life. It is used either directly or indirectly in our daily activities (Onoshakpokaiye, 2011). Living without mathematics knowledge would have made this life very difficult because every human need and use it knowingly or unknowingly, whether educated or non-educated. Anything that involves counting and calculation is mathematics.

Mathematics is a distinctive subject, which encourages the development or acquirement of specialized knowledge or skills in sciences that explain the natural phenomena of social life (Das, 2019). It is of great value to everyone and the nation's growth both technological and economic (Ameen, Adeniji, & Abdullahi, 2019). Mathematics has been portrayed as an essential tool for the progress of any society and it is the foundation of science and technology, its skills and knowledge are the basis of the societal change that can convert ideas into reality (Otunu-Ogbisi & Ukpebor,2009, Onoshakpokaiye, 2020a).

Mathematics has been declared as the queen of all sciences due to its importance to sciences. It is an indispensable subject for the improvement of science and technology thus,

no country can in this present dispensation or world progress as regards scientific and technology without recognizing mathematics (Alata, 2017). Many developed or advanced nations we have today got to where they are as a result of mathematics recognition because it is the foundation and language of science and technology. For students to benefit from this subject of mathematics, the student should be well introduced to or taught the foundational mathematics early in life to arouse their interest in the subject.

The nature of ICT

The word ICT represents Information and Communication Technology. ICT can be explained as the storage, giving out of information, managing of diverse sets of resources and technical tools that are acceptable in information and communication technologies. Blurton (2002) opined that ICTs are seen as a different set of devices and technological tools utilized to store, converse, and share out, generate, and manage information. Information and Communication Technology (ICT) is made up of different devices and technology resources that are applied to manoeuvre and compare information (Kaware & Sain, 2015, Zakaria & Khalid, 2016). The ICTs are tools that include electronic gadgets which are employ for the institutions, students and organizations' needs. A few examples of electronic devices utilized are the computers, multimedia, telephones, projector, networking, video and the internet (Nwakundo, Oguejiofor & Nwakundo, 2006, Ameen, Adeniji, & Abdullahi, 2019). The ICT is a very wide area which includes the making use of autographs, computers, software and hardware and others which support learning-teaching. It has become one of the main structures of building our contemporary society today. The ICT advancement has been anticipated to help meet up with the necessities of the education system (Chao, 2015, Das, 2019). Prytherch (2000) opined that ICTs are networks which make available the latest prospects for learning, training and teaching through digital delivery content.

The ICT utilization in education assists in the improvement of critical thinking and scientific skills between the educators and learners. ICT permit the production of digital resources like that of digital libraries, where teachers, students and professionals can have access to course resources and study resources from wherever they are at any time (Das, 2019). It arouses the students' interest to partake in the learning activities from everywhere at any time. It assists in the exchanging and sharing of ideas among the teachers for skilled improvement. The ICT is transforming the Mathematics teaching-learning processes by putting essentials life into education and classroom environments.

The position of ICT

ICT is a device that complements the process of teaching-learning and embraces the guarantee of new way out to all educational problems (Oduma & Ile, 2014, Das, 2019). The ICT utilization creates a great or good learning atmosphere, and changes the method of teaching-learning whereby students acquire the knowledge in a self-directed, constructive and active way (Volman & Van Eck, 2001, Ameen, Adeniji, & Abdullahi, 2019). The ICT use has transformed the conventional traditions of teaching and learning and put forward a call for education rethink in conditions of a further up to date context (White, 2010). The ICT is frequently seen as a vehicle to change the teaching method, and strategies to learning and accessing information (Watson, 2005, Ameen, Adeniji, & Abdullahi, 2019). Guzel (2011) stated that the effectiveness of employing the computing device during teaching has contributed immensely to mathematics teaching-learning. The ICT can be seen as an essential device applied to support or add to the conventional methods of teaching but not as a substitute for the existing teaching technique and it should be utilized to develop the students' skills in problem-solving, communication and lifelong mathematics learning (Voogt, 2003, Ameen, Adeniji, & Abdullahi, 2019).

Due to the ICT significance to mathematics teaching-learning, the mathematics teachers and students must be acquainted and familiarized themselves with the ICT resources utilization to develop the efficiency of mathematics learning-teaching. Teaching as a profession is changing to become a more complex and most demanding vocation due to a speedy increase of knowledge that needed up to date technologies that call for ICT application. Many nations are now regarding the ICT, and mastering its basic concepts as component of the foundation process of learning- teaching in education (UNESCO, 2002, Ameen, Adeniji, & Abdullahi, 2019).

The ICT prospect is a hopeful practice in mathematics teaching- learning, but the accomplishment of this exercise is not a simple task, it lies solely on several issues, which embrace attitudes of teachers toward the contribution of ICT to the teaching-learning of mathematics, perceptions of teachers about the ICT skills and dispositions of teachers toward the contribution of ICT.

ICT utilization in the teaching of mathematics

The ICT application in the teaching-learning of mathematics has conveyed a new knowledge for both the learners and educators in various countries (Mazana, Montero & Casmir, 2018). The ICT application exposes the students to a variety of skills that are connected to their upcoming needs such as utilizing email, Microsoft Word and excel, and browsing the internet for lifetime learning processes (Gabare, Gabarre, Din, Shah, & Karim, 2014; Khalid, 2014; Jones, 2011, Zakaria & Khalid, 2016). The ICT application is becoming more fundamental in education since it assists in the improvement of a practical teaching-learning situation (Gabare, Gabarre, Din, Shah, & Karim, 2014, Daud & Khalid, 2014).

With the arrival and development of technology, the teachers or educators are encouraged to include ICT into their teaching to complement traditional methods of teaching (Kiflee &
Khalid, 2014). The ICT is not just a device for teaching-learning rather it works as a powerful force for the teachers to play their role in education (Nur & Hazman, 2006, Zakaria & Khalid, 2016). The ICT application can assist the teachers in obtaining resources from the internet that will assist them to transform their method of teaching. The ICT use is expected to refine and raise the qualities of the teachers' teaching and students' learning (KPM, 2013). It is a process of appropriating technology to different teaching and the learning situation, be it inside or outside the classroom setting (Norazrena & Khairul Anuar, 2011; Nur & Hazman, 2006, Zakaria & Khalid, 2016).

Integrating ICT into education could add to students' ability based on universal needs through knowledge increase and shaping of skills (Storm, 2011, Zakaria & Khalid, 2016) and also improve students' supportive learning through a community of practice (Khalid et al., 2013, 2014, Zakaria & Khalid, 2016). Bature (2016) stated that efficient ICT utilization enhances problem-solving skills, the teaching- learning process and arouses the students to study. Baya'a and Daher(2013) stated that ICT tools integration into mathematics teaching-learning afford teachers with effective methods that arouse students' interest to be active and autonomous in learning. According to Ittigson and zewe (2003) in Alata(2017) technology is indispensable in teaching mathematics. ICT assists the students in understanding basic concepts in mathematics and improves how mathematics is taught or handled in schools.

Agyei and Voogt (2011) affirmed that the ICT resources utilization encourages students to search and comprehend concepts of mathematics thereby advancing the students' problem-solving skills and thinking of higher order. These tools embrace computers, online tools, internet facilities and software packages in mathematics. Prior studies revealed that the

ICT tools utilization in the classroom influences the outcome of the student (Bature, 2016). These ICT tools offer students a good learning ground for representing mathematics various concepts and the procedures that will assist them in gaining a deeper knowledge of mathematics concepts (Baya'a & Daher, 2013). Miglani and Awadhiya (2012) stated that for the execution this technology to be successful, the harmonized efforts of teachers, students and the school management are required.

The accomplishment of ICT incorporation into the classroom lies in the willingness of teachers to include these ICT tools into the school curriculum and utilized them to enhance students' learning (Kumar, Rose, & D'Silva, 2011). The motive behind providing ICT facilities lies within the ICT promises in improving the teachers' efficiency and student learning attainment.

The problems of utilizing ICT in mathematics teaching-learning

Despite the numerous benefits and advantages of the incorporating ICT in the mathematics teaching, there are still some problems being encountered by the mathematics teachers when applying the ICT. According to Mazana, Montero and Casmir (2018), research studies conducted in Tanzania discovered that several challenges hamper effective mathematics teaching such as graphical visualization tools, scarcity of textbooks and references; models and insufficient students support due to classrooms congestion. Some of the problems are lack of technical support, reduced teaching time in the classroom, lack of trained manpower on the ICT tools utilization, inadequate training on the ICT utilization, inadequate resources for students when they are at home, government insensitivity toward the provision of ICT facilities and inadequate instructive knowledge on applying this ICT to teach (Afolake & Shittu, 2005; Keong, Sharaf, & Daniel, 2005, Zakaria & Khalid, 2016).

Lack of technical support in the incorporation of ICT into mathematics teaching includes the provision of inadequate computers for students; it takes a very long time for the spoiled equipment to be repaired or replaced and the inadequate computer skills of teachers. Students are not allowed to utilize the required ICT tools to assist them in learning in school and also when at home. They do not own computers and have no internet access and so learning through ICT resources is only limited to the school (Keong et al., 2005; Ruthven, Deaney & Hennessy, 2009). Also, the teachers own no computers and no internet accessibility or the required technology; these teachers have a problem in preparing materials for mathematics teaching.

Most developing countries' institutions do not provide internet services/facilities for their staff and so accessing the internet becomes another major problem. Staffs who manage to provide for themselves bear the cost of their internet subscription. Besides this problem, some developing countries still lack a good electricity supply to use the ICT resources if available (Onoshakpokaiye, 2020b). With these, using the ICT during teaching becomes a problem. ICT, if efficiently utilized can aid educators and learners in triumph over these problems thereby improving the teaching-learning process which will eventually result in the improvement of students. For it to occur, the ICT tools should be provided for teachers and students to utilize and they also should possess the required skills of these ICT tools incorporated into mathematics teaching.

The willingness of utilizing ICT in Mathematics Teaching

Willingness can be explained as the accessibility of capital and capabilities to execute a certain activity that requires infrastructure and specialized skills (Miglani, Awadhiya, 2016, Mazana, Montero, & Oyelere, 2019). Despite the ICT benefit, there remain lots of teachers who lack computer skills to utilize ICT to support their classroom teaching. Onasanya, Shehu, Ogunlade and Adefuye (2011) in the study conducted by them on the

awareness of teachers and the extent of utilizing information communication technologies for successful science and health education in Oyo State, Nigeria. Their findings exposed that there exists ICT resources employment level by these teachers for teaching health education and science which is low and also there exists a significant disparity among the female and male science educators as regard to their ICT utilization level, with the male doing better than the female teachers.

A study done in Kenya by Joseph (2011) discovered there exists an insufficient infrastructure and poor internet connection in the colleges. The study conducted by Ngeze (2017) cited by Mazana et al, (2019) to study teachers in a secondary school as regard to ICT willingness in Tanzania schools, established that schools had insufficient infrastructure. The findings confirm that 77% of teachers studied have a smart phone, a laptop or both, ready to apply such tools when teaching but lack the skills. The result implies that using ICT in teaching in a mathematics classroom can improve interactions and communication between the students and teachers thereby minimizing the problems that are formed with geographical restrictions passed through in conventional teaching methods.

In school, the few available computers tend to be utilized for administrative purposes only. In making the ICT application to be significant to teaching mathematics, there are certain skills required from mathematics teachers to possess or master which are: i) the mathematics teacher must be knowledgeable and competent ii) the teacher's ability to utilize the learning resources and instructional media that are appropriate to the students' characteristics and the subjects being taught, iii) the teacher capability to apply technology in teaching iv) the teacher ability in utilizing ICT to converse and build up themselves.

With the introduction of ICT, teachers' systems of teaching have greatly been affected by its utilization in teaching mathematics (Zakaria & Khalid, 2016). Yusuf (2005) opines that the education sector has greatly been influenced by ICT, which thereby has undeniably affected learning-teaching. Sanmi(2016) in Ameen, Adeniji and Abdullahi (2019) advised that students ought not to be taught how to obtain an in-depth knowledge of subjects only rather they ought to be made to identify how new knowledge can be generated or acquired using the ICT.

Benefits of applying ICT to Teach Mathematics

For effective ICT incorporation in the school the following benefit will be achieved i) the efficient ICT utilization will help to speed up and deepen student's comprehension of mathematics basic concepts and skills which will assist them in studying and sustain their curiosity in the subject-mathematics ii) the effective utilization will challenge the students to learn mathematics to be independent and therefore be in charge iii) the effective use of ICT will assist the students in updating their academic knowledge and also update and improve mathematics teachers' instructional practices iv) the efficient ICT technology use will provide the teachers with well-organized and efficient tools to take care of individual variation that exist amongst the students.

Countless benefits accrue if the ICT tools are efficiently implemented in mathematics teaching. Additional benefits are i) improving the effectiveness of mathematics teaching ii) improving the worth of mathematics teaching iii) making the mathematics teaching atmosphere to be extra enjoyable, pleasant and interesting. Another benefit or gain of utilizing ICT is to build interaction among the students in mathematics class (Keong, Sharaf, & Daniel, 2005; Neurath & Stephens, 2006, Zakaria & Khalid, 2016). The application of technological devices fosters communication between students to exchange their skills and knowledge. Result from researches shown that students' cooperation happened when

opportunities were given to them to show their effort with the support of ICT (Zakaria & Khalid, 2016). Technologies applications like the internet assist the students in self-explored the internet which leads them to understand basic concepts in mathematics they have learnt (Keong et al., 2005; Ramli, Latifah, Noor, & Abd Rahman, 2006, Zakaria & Khalid,2016). The ICT utilization can also enhance students' concentration and their motivation toward mathematics.

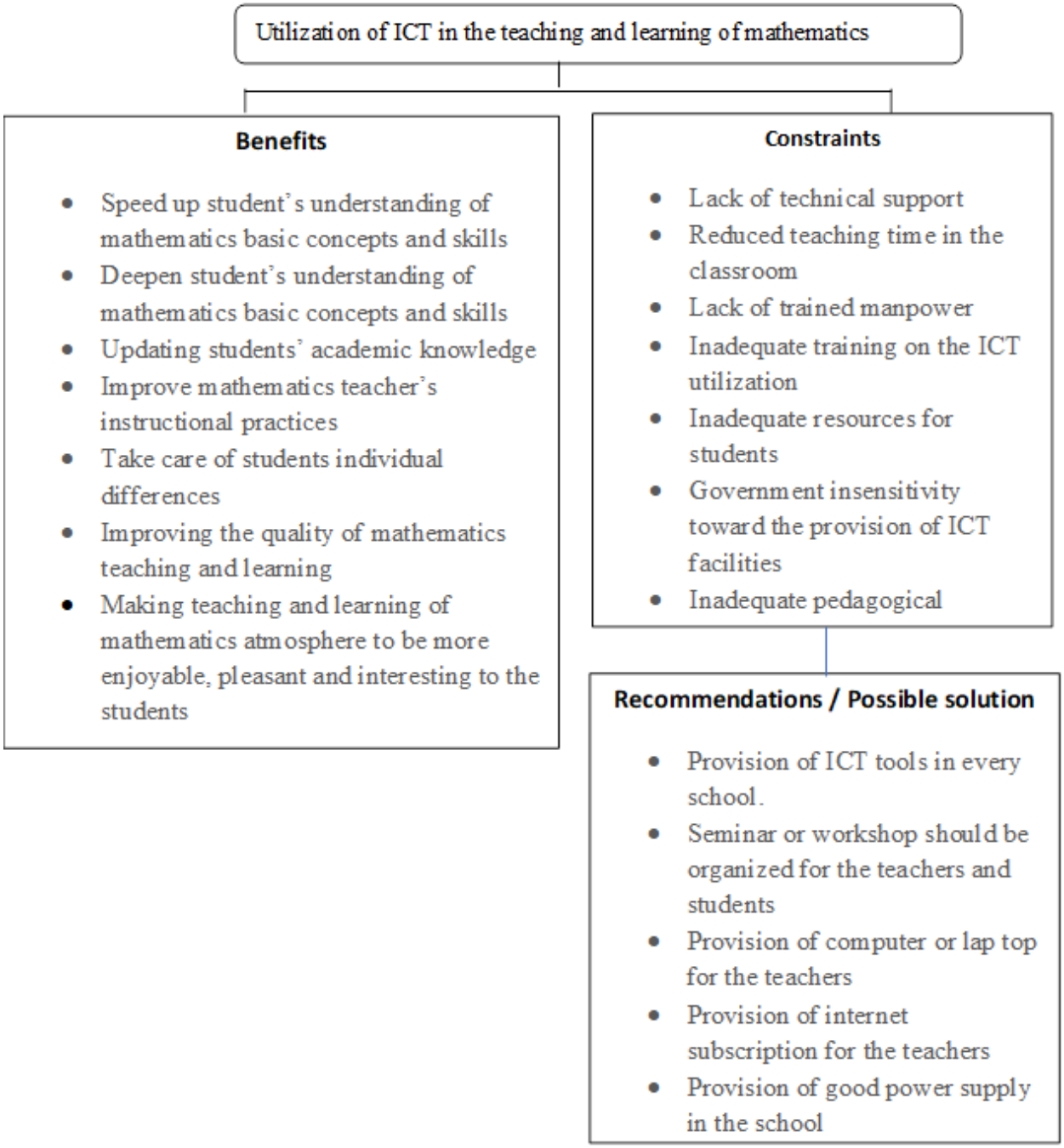

Figure 1. Rundown of benefits, constraints and recommendations/possible solutions as per ICT utilization in the teaching/learning of mathematics.

Some ICT tools utilized for mathematics teaching

Research has revealed some ICT technologies that can be applied in mathematics instruction such the DERIVE, Microsoft Excel, MAPLE software and MATHEMATICA for

teaching algebra are now being utilized due to ICT incorporation in mathematics instruction (Neurath & Stephens, 2006, Keong et al., 2005). Microsoft Excel utilization has helped students in carrying out mathematics problem-solving related to algebra, like equation graphs construction, finding the straight line slope and simplification of equations and others. MAPLE is utilized also to support students in solving problems relating to equation graphs construction in algebra.

Software for learning has also been developed for some mathematics topics. For case in point, the computer-based software for fractions was developed which was founded on ASSURE model of learning. Software for students of special needs has been constructed founded on the ADDIE model of learning. The above software types play the function of added exercises and obtaining notes for fraction topics (Zakaria & Khalid, 2016). Stephen and Konvalina (2006) cited by Zakaria and Khalid (2016) researched on the efficiency of a program called MAPLE for algebra using secondary school. The study revealed that MAPLE improved students' positive attitudes towards algebra. They ended that the MAPLE program improved the achievements of students by 5% as soon it was applied to complete assignments in algebra. It revealed that students who opted to use MAPLE to finish their assignments have improved performance in their concluding examinations.

Hanim and Hairulniza (2002) develop software in mathematics that is found on a model-the ASSURE model, it was utilized in fractions for Form 1 in the secondary school. This model has six developmental stages, they are Analysis, Stating, Selecting, Utilize, Require and Evaluation. Norazrena and Khairul (2011) cited by Zakaria and Khalid developed software found on a model called ADDIE which means Analysis, Design, Develop, Implement, and Evaluation, the software is found on computers for learning - teaching fractions topic in mathematics. The model was developed to examine the special needs students' knowledge of basic concepts in fractions. Their study was carried out using special needs' students in secondary school. The software content is found on fractions basic concepts which embrace the addition of fractions, fractions subtraction, improper fractions and proper fractions. This software was invented specifically to study form 1 students who have special needs. The researchers discovered that those students who partake in the study have improved achievements after utilizing the software during the mathematics learning process. In the research, they discovered that the software helped in reducing the students' cognitive load during the period of their learning mathematics, this is because, the software content utilized straightforward examples which were plainly explained to the students' understanding. This software may as well be useful or effective for students of non-special needs to boost their understanding of fractions' basic concepts.

Various ICT tools are applied in mathematics teaching both in the primary, and secondary schools and even in the higher institution. The employment of these ICT tools performs the function of aids to teaching in assisting the students working on their mathematics assignments and acts as revision resources to the students, during the period of school lessons or at home.

Recommendations

From the review of literature so far, the researcher, therefore, recommends the following: The incorporation of the technology must not be overlooked because of its immense benefits to mathematics learning and teaching. Government and those in charge of education should blaze up to ensure these ICT tools are made available in every school. Government should make sure that educators and learners of mathematics are admitted to these ICTs when provided. A seminar or workshop should be organized for the learners and educators to be educated on the ICT facilities and their usage.

Computer or laptop and internet subscriptions should be provided for the mathematics educators for them to effectively utilized and plan their teaching both in school and at home. The management of the school should ensure there is a good power supply to help the teacher efficiently apply the ICT tools when provided. If this is done there will an improvement in the learning/teaching of mathematics.

Conclusion

The ICT incorporation is not debatable from the literature that has been reviewed. Effective mathematics teaching is essential for ICT incorporation into education. Most students regard mathematics as a dreaded subject because of its abstract nature of the topics. To end this student's notion or attitude that is why ICT application is urgently needed by every country whether developed or developing. Some developing countries now saw the necessity of ICT utilization in schools during the pandemic period, some of their schools were shut down due to insufficient ICT facilities and shortage of manpower, and they could not adopt the online study. Every nation needs ICT incorporation in their school because education is the engine of the growth and progress of every country in all ramifications.

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