

INTEGRATING INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN SCIENCE, TECHNOLOGY AND MATHEMATICS EDUCATION IN NIGERIA: PROSPECTS AND CHALLENGES

BY

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ABSTRACT

Globally, the impact of Information and Communication Technology (ICT) in the past decades has been enormous. ICT plays a crucial role in socio-economic development and in bringing the world together as a global village. Indeed, in today's knowledge based economy, a completely new set of skills are required. Developing countries need to respond to demand for strategies to prepare the youth for the competitive opportunities driven by information and communication technology. The adoption of ICT and its integration in teaching and learning have met challenges. This paper highlights the prospects of integrating ICT in STM Education, the conditions for ICT integration in Education, Challenges of ICT-driven education in Nigeria and the ICT initiatives in Nigerian educational system. Among the recommendations made include adequate funding of ICT-driven initiatives in the education sector and a sound policy environment which encourages investment in ICT.

Keywords: ICT, Integration, Prospect, Challenges, Mathematics, Education

Introduction

Science, Technology and Mathematics (STM), has altered economic, social and environmental conditions of mankind in the areas of food production, medicine, transportation and communication, environmental improvement and protection as well as energy production and renewal. The utilitarian value of STM is being enhanced the world over, through the infusion of Information and Communication Technology (ICT). According to Wachira & Keengwe (2010), ICT integration in education means incorporating ICT and technology-based practices into all aspects of teaching and

learning. Specifically, incorporating appropriate technology in objectives, lessons, and assessment of learning outcomes. Technology in the context of teaching and learning involves the use of computers with appropriate educational software. Integration of ICT can be achieved when students learn with computers in ways that include using computers efficiently and effectively in the general content areas which allows them to learn how to apply computer skills in a meaningful way, using real-life software applications that will help students learn to use computers flexibly, purposefully and creatively. Information and communication technology (ICT) is a force that has revolutionized all spheres of life in general and education in particular. It has reduced the whole world into a global village.

An integral part of Education and a social necessity use of ICT are widely accepted and appreciated. ICT includes any technological device or application used for communication. These technological devices such as radio, television, computer, cellular phone etc. are also used to collect, generate, distribute, administer and disseminate information(sajad, 2019).It also provides various services such as video conferencing and distance learning.

The impact of ICT on learning is in relation to use of digital media, primarily computers and internet to facilitate teaching and learning. ICT resources are easy to access, readily available and user friendly. In educational context ICT stands for any technology used in conveying, manipulation and storage of data by electronic means. The fact is that ICTs have provided a helping hand in uplifting the overall education system, but despite that, the impact of ICT services on academia has been minimal in the world as a whole. It has put an end to the barriers of space and time (*Damkor, Irinyang & Haruna, 2015*)

ICTs also allow for the creation of digital resources like digital libraries where the students, teachers and professionals can access research material and course material from any place at any time (Bhattacharya & Sharma, 2007).

ICTs have the potential to accelerate, enrich, and deepen skills, to motivate and engage students, to help relate school experience to work practices, create economic viability for tomorrow's workers, as well as strengthening teaching and helping schools change (Davis & Tearle, 2010; Yusuf, 2011).

Despite the enormous benefits of this modern technology, many STME teachers in Nigeria still lack the necessary ICT skills needed to meet the realities of the classroom, the new challenges posed by the new information and communication technology, students current learning needs and the societal expectations as well as the national and international labour market in case of teacher migration (Steve & Jacintha , 2012). STME teachers needs to catch up by been inducted into the digital age right from their first year in the teacher education programme till the final year so that the knowledge and skills in ICT will get permeated to them. Numerous efforts by Federal Government

have been made to enhance teacher education through full integration of the use of ICT. There is no doubt that ICT is inevitable in every teacher education programme or institution in Nigeria but its integration in teaching – learning process will depend on teachers knowledge, competence and willingness to use and model it to their students.

Need for ICT Integration in Education

ICT application and use will prove beneficial in improving Nigeria's educational system and gives student a better education. Grabe & Grabe (2007) points out that in the present information society, a country could choose to be an e-tiger (a country determined to take radical policy decisions to be a front runner), e-floater (a country trying to keep pace with the most dynamic countries), e-follower (a country that makes the best use of what reaches it in due course), or e-skeptic (a country which does not believe in the transformation and development potential of ICT and does not take any active step). So only the first two can stay networked. The best will receive residual e-fallout (willing in the case of e-follower and unwilling in the case of e-skeptic). A technologically-advanced workforce will lead to ICT growth in Nigeria, with the potential to improve military technology and telecommunications, media communications, and skilled ICT professionals who will be well-equipped to solve IT problems in Nigeria and other parts of the world. New instructional techniques that use ICTs provide a different modality of instruments. For the students, it has offered a choice able alternative to the traditional classroom learning(Damkor, Irinyang & Haruna, 2015).

ICT use allows for increased individualization of learning. In schools where new technologies are used, students have access to tools that adjust to their attention span and provide valuable and immediate feedback for literacy enhancement which is currently not fully implemented in the Nigerian school system. It has potential benefit of removing once for all the geographical constraints which have always been seen as a challenge for a geographically diverse based country like Nigeria. Not only this, ICT enabled education also has removed some of the temporal constraints that learners and teachers usually experience such as time barriers (Bhattacharya & Sharma, 2007). It also provides speedy dissemination of education to target disadvantaged groups (Chandra & Patkar,2007). Not only this, ICT is used for non-formal education like health campaigns and literacy campaigns. It can promote gender equity (UNICEF & UNESCO, 2011). ICT based equipment such as smart phone use enhances the academic achievement of students (Mir & Paray, 2018). It provides a platform for collaborative learning for students with continuous evaluation and feedback on an individual basis. The demand for computer/ICT literacy is increasing in Nigeria, because employees realize that computers and other ICT facilities can enhance efficiency. On the other hand, employees have also realized that computers can be a threat to their jobs, and the only way to enhance job security is to become computer literate.

With the high demand for computer literacy, the teaching and learning of these skills is a concern among professionals. This is also true of other ICT components. Improved education is essential to the creation of effective human capital in any country. The need for ICT in Nigerian schools cannot be overemphasized. In this technology-driven age, everyone requires ICT competence to survive. Organizations are finding it very necessary to train and re-train their employees to establish or increase their knowledge of computers and other ICT facilities. This calls for early acquisition of ICT skills by students.

Essential Conditions for ICT Integration

For technology to have the desired impact on improved teaching and learning, essential conditions must be in place. When the International Society for Technology in Education (ISTE) established National Education Technology Standards (NETS) for teachers, students and administrators, they also described conditions that are necessary for teachers to exploit the potential power of technology. These conditions are discussed below (ISTE, 2009; Roblyer,2006):

Shared vision

Proactive leadership in developing a shared vision for educational technology among all education stake holders including teachers and support staff, school and district administrators, teacher educators, students, parents, and the community is necessary. Stakeholders at every level should be empowered to be leaders in effecting change. There must be a systemic plan aligned with a shared vision for school effectiveness and student learning through the infusion of ICT and digital learning resources. Ongoing funding to support technology infrastructure, personnel, digital resources and staff development should also be planned for.

Equitable access

Robust and reliable access to current and emerging technologies and digital resources, with connectivity for all students, teachers, staff, and school leaders is a necessity.

Skilled personnel

Educators, support staff, and other leaders skilled in the selection and effective use of appropriate ICT resources remain an essential condition. Technology integration skills cannot be learned through passive observation. Technology-related professional learning plans and opportunities need to be in place and dedicated time needs to be assigned to practicing and sharing ideas.

Technical support

Consistent and reliable assistance for maintaining, renewing, and using ICT and digital learning resources is essential.

Curriculum framework

Content standards and related digital curriculum resources that are aligned with and support digital age learning and work are necessary in technology integration activities. Planning, teaching, and assessment need to be centered on the needs and abilities of students. Continuous assessment of teaching, learning, and leadership, and evaluation of the use of ICT and digital resources should be taken into consideration.

Engaged communities

There must be partnerships and collaboration within communities to support and fund the use of ICT and digital learning resources.

Support policies

These refer to policies, financial plans, accountability measures, and incentive structures to support the use of ICTs and other digital resources for learning and in district school operations. These include policies and initiatives at national, regional, and local levels to support schools and teacher preparation programmes in the effective implementation of technology so as to achieve curriculum and learning technology standards. There must be partnerships and collaboration within communities to support and fund the use of ICT and digital learning resources

ICT Initiatives in Nigerian Education System

In recognizing the critical role of ICT in the advancement, attitudes and skills necessary for effective teaching and learning, the Federal Ministry of Education made several efforts to integrate ICT in schools. The Federal Government of Nigeria, in the *National Policy on Education* (Federal Republic of Nigeria, 2014), recognizes the prominent role of ICTs in the modern world, and has integrated ICTs into education in Nigeria. To actualize this goal, the document states that government will provide basic infrastructure and training at the primary school. At the basic school, computer education has been made a pre-vocational elective, and is a vocational infrastructure and training for the integration of ICTs in the school system.

It should be noted that 2004 was not the first attempt the Nigerian government made to introduce computer education in schools. In 1988, the Nigerian government enacted a policy on computer education. The plan was to establish pilot schools and diffuse computer education innovation first to all secondary schools, and then to primary schools. Unfortunately, the project did not really take off beyond the distribution and installation of personal computers (Aduwa-Ogiegbaen & Iyamu, 2008).

Aduwa-Ogiegbaen & Iyamu (2008), concludes that the computer is not part of classroom technology in more than 90 percent of Nigerian public schools. This implies that the chalkboard and textbook continue to dominate classroom activities in most

Nigerian secondary schools. The Federal Ministry of Education has launched an ICT-driven project known as School Net (www.snnng.org) (Federal Republic of Nigeria, 2006; Adomi, 2005), which was intended to equip all schools in Nigeria with computers and communications technologies. In June 2003, at the African Summit of the World Economic Forum held in Durban, South Africa, the New Partnership for African Development (NEPAD) launched the e-Schools Initiative, intended to equip all African high schools with ICT equipment including computers, radio and television sets, phones and fax machines, communication equipment, scanners, digital cameras, and copiers, among other things. It is also meant to connect African students to the Internet. The NEPAD capacity-building initiative will be executed over a ten-year period, with the high school component being completed in the first five years. Three phases are envisaged, with fifteen to twenty countries in each phase. The phases are to be staggered, and an estimated 600,100 schools are expected to benefit. The aim of the initiative is to impart ICT skills to young Africans in primary and secondary schools, and to harness ICT to improve, enrich, and expand education in African countries (Aginam, 2006).

The Nigerian Federal Government has commissioned a mobile Internet unit (MIU) operated by the Nigerian National Information Technology Development Agency (NITDA). The MIU is a locally-made bus that has been converted into a mobile training and cyber centre. Its interior has ten workstations, all networked and connected to the Internet. The MIU is also equipped with printers, photocopiers, and a number of multimedia facilities. Internet is provided via VSAT with a 1.2m dish mounted on the roof of the bus. It is also equipped with a small electric generator to ensure regular power supply. The MIU takes the Internet to places and various primary and high schools (Ajayi, 2003). The number of buses is so small; however, that most rural areas and schools have not yet been covered. Although efforts have been made to ensure that ICTs are available and used in Nigerian schools, the level of uptake is still low.

The ICT revolution is yet to attain that critical mass required for it to register the necessary impact in the teaching students and civilian population nationwide. While some schools could be said to be in the vanguard, the majority of Nigeria's universities, polytechnics, nursing and midwifery schools, and colleges of education lack computers. Many of the lecturers in these public institutions have to go to commercial cyber cafés before they can have access to a computer. From the foregoing, it is obvious that Nigeria's goal to actualize the potentials of teachers and to improve the quality of education to meet the international standards cannot be achieved without taking into cognizance the urgent need for adoption of appropriate integration of ICT in the STM education programmes in Nigeria.

Prospects of Using ICT in STM Education

It has become very imperative for Nigeria Nation to engage a number of efforts to effect changes in the teaching/learning process to prepare students for information and

technology based society. This impression is built on the realization of the potentials of ICT which provides an array of powerful tools that could transform the present learning environment. The prospects of ICT use in STM Education are presented under the following subheadings.

ICT in Teaching and Learning Process

Academics have taken ICT in teaching-learning process for a good number of reasons such as inaudio-video conferencing, digital libraries, e-resources and e-learning, virtual and blended

learning, distance and online learning, communication and collaboration purposes etc. Jones & Preece (2006) reported that both students and teachers need to learn to trust the technology for technological performance as well as enhance the uptake and reduce resistance to technology. Teachers need to be confident and competent in using various ICT tools to build their trust in the technology. Without teachers' competency and mastery skills of ICT integration which is appropriate to their needs, ICT could not be put into good use for instructional delivery. In this regard, teachers should have a range of different technical and communication skills which include using chat rooms, word processing skills, web page authoring and using various kinds of ICT tools such as File Transfer Protocol (FTP), compress and decompress of files, e.g., Win zip and so forth.

ICT in Administration

ICT serves various administrative functions in higher education like maintaining financial records of the institutions, networking with local and foreign institutions, e-payments and biometric attendance of employees. It is also vital for keeping and maintaining the student's cumulative records, academic track record, placement opportunities, uploading and downloading of course content and online tests for scholastic and non-scholastic activities. Besides these, maintenance of staff details, their pay scale details, grade performance of staff members etc. are also kept recorded with the help of ICT based devices and applications.

ICT in Research

Use of ICT in research is powerful and most uncontroversial in nature. ICT provides a worldwide platform for researchers to access and process the data in a broader way. The researchers can collect required data from target population in an online mode without casting much money, energy and time. After collecting the raw data, the research make most use of ICT based statistical software's such as statistical package for the social sciences (SPSS) in order to analyze the data. This kind of data analysis is quick and accurate without using cumbersome manual task from researchers.

Challenges of ICT in Education

Despite the numerous efforts by the federal ministry of Education and other agencies and international organization in accelerating the application of ICT in Nigerian schools, there are still problems of effective implementation of ICT in all levels of Education in Nigeria. Such challenges include:

1. Resistance to change from traditional pedagogical methods to more innovative, technology-based teaching and learning methods, by both students and academics. The attitudes of various managements in and outside institutions towards the development of ICT related facilities such as the Internet and procurement of computers is rather slow in some instances, and in others there are no aids or support by the government at all (Adeyemi & Mary, 2013)
2. Problem of regular power supply in Nigeria. The issue of power supply has been a great challenge to the development and use of ICT. The situation is such that even the little ICT facilities available may be dispensed on stand- by power.
3. Inadequate ICT infrastructure including Computer hardware and software and bandwidth/access.
4. Lack of qualified ICT personnel. Most institutions lack computer literate teachers and ICT experts that would support and manage the Internet connectivity and/or application of computing in the teaching-learning process. The cost of equipment in a country like Nigeria with a battered economy and seriously devalued currency is enormous.
5. Inadequate funding and Budget slash. The overall educational system is underfunded (Okafor, 2011). Therefore available funds are used to solve more urgent and important survival needs by the institutions. Development and subsequent operation of ICT require huge financial investment in, and commitment to the acquisition of necessary facilities and their maintenance.
6. Lack of Awareness and Negative Attitude to ICT. Many teachers still have vague idea of ICT. Some see it as an advanced technology that is very expensive, requires advanced skills and its introduction will rob many of their jobs.

Conclusion

Education the world over is being redesigned to fit more into the electronic age for the purpose of efficiency. Information and Communication Technology is a powerful tool for enhancing quality education in our Educational Institutions. The tremendous potential of ICT in promoting the learning outcome with more latest of knowledge without and obstruction on accessibility and distance limitation, and yet straighten students' thinking skills is undeniable .With ICT integration in the classroom, students will be able to engage in interactive tasks with a wider range of information and knowledge during their learning. At the same time, the teachers' beliefs and attitudes will influence them to integrate ICT in their teaching practice. With the full support of

Nigerian Government in integrating ICT in Education, teachers will be able to access updates and richer resources to improve their teaching practices. The teaching and learning with ICT specific in internet accessibility will make the teaching and learning knowledge borderless and create a virtual learning environment for both teachers and students.

Recommendations

The following key points are considered as recommendations for the development of ICT-driven Education in Nigeria.

1. There is a need for providing adequate ICT infrastructure facilities at all levels of education.
2. ICT integration in education has suffered a lot of obstacles, it is suggested that a collaborative research needs to be undertaken by stakeholders to explore the possible solutions for the fullest possible integration of ICT in Education.
3. Encouragement of the participation of STM teachers and Administrators in ICT training to increase positive beliefs about teaching with ICT and understanding of its potential in improving students' learning outcomes in STM;
4. More financial inputs are needed for the long term and far reaching integration of ICT in Education.
5. Cost effective ICT services needs to be provided so that they are within the reach of the less privileged and marginalized people of the country.
6. Availability of in-service training to develop and continuously update teachers' knowledge and skills for didactically meaningful implementation of ICT in the teaching practice of STM courses.
7. Subject specific ICT-based resources and e-learning platforms accompanied by training need to be provided to teachers so that their STM related knowledge can be promoted.

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