Information and Communication Technology (ICT) in Mathematics Education: Challenges and Prospects

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Abstract
The paper discusses the importance of mathematics education and role ICT can effectively play in the teaching and learning of mathematics. Mathematics Education is one of the manpower development programmes of study that is attracting the attention of various countries around the world. This development equally qualifies it to be seen as one of the most important programmes that tackles the menace of poverty and create employment skills. Therefore, deployment of information and Communication Technology (ICT) in Mathematics Education courses is paramount and should be given priority. The paper identifies physical facilities, staffing, libraries, laboratories and academic content as some inadequacies that need to be addressed in mathematics Education. It also identifies the enabling environment and deficient utilities such as erratic power supply, poor networking which are some of the current bottleneck at one hand and as well, socio-economic and institutional factors at the other hand militating against the integration of ICT in to Mathematics Education in Nigeria. With globalization of mathematics education, it suggests that ICT will ultimately provide solution to many difficulties being faced by the sector through many of its tools if effectively integrated.

Keywords: ICT, Mathematics Education, teaching and learning effectiveness
Introduction

Information and Communication Technology (ICT) has been described as the frontier hero of the new century, driven by ambition and full of courage: replicating itself like a virus and sweeping all before it. Being neither passive nor moral, it is affecting everything it touches, marginalizing those who will not give it its due. Surely, the much of information technology has influenced virtually all areas of human endeavour. This invasion is often welcome. Sometimes a nuisance and occasionally labeled as an outright evil to be resisted at all costs. One thing, however sure, is that information technology is here to stay with us. We usually find ways of accommodating it when we must, coping with it to our advantages when our work can be enhanced by it (Christines et al, 2001). Education to a large extent and in the most general sense is being revolutionized by ICT. In many quarters, enthusiasts have even gone as far as saying that ICT is redefining education. They point to the fact that if the pace of change in the ICT revolution continues, the classroom, as we see it today, is up for a thorough shake-up. In fact, internet now provides for information and instruction in ways that could not have been anticipated a mere decade ago. As the world continues to extend communication infrastructure to the developing and marginalized countries, more and more people will begin to reap the benefit of cyber-schooling.

In educating scientists and engineers, the new technologies offer new challenges even as they promise us enduring benefits. While the obvious benefits are universal the same cannot be said of the challenges. By way of benefit, we expect to have an easier time imparting the rudiments of science or engineering education to students and augment the laboratory and practical components with the animation, simulation and visualization facilities of ICT. The challenges are far from universal in that any technology does not exist or propagate in a vacuum, but is circumscribed by the social, cultural and economic environment of the society in which it operates. Thus, the challenges confronting ICT vary as widely as the variations encountered in the levels of industrialization and accessibility to the internet in the society.

However, we must take cognizance of the fact that we are at the dawn of a new area, it is an era of technology and most things are no longer what they used to be. Technology is revolutionizing the way we see ourselves, define our existence, conduct our lives and do business.

Mathematics Education

Mathematics education understood in its simplest form and most concrete sense concerns the activity or practice of teaching Mathematics. Looking at the aims of teaching Mathematics, it is important to note that aims, goals, purposes, rationales, do not exist in vacuum. They belong to people, whether individuals or social groups. Mathematics has been identified as an indispensable subject in many fields; Badmus (2002) in Obarakpo (2009) opined that a basic Mathematics education for all children is not a luxury but absolute necessity. Mathematics is predominantly a service subject because it produces skills that should be used in other areas of endeavour like science, technology, business, medicine, humanity, e. t. c. The growing needs in these areas place a burden on the subject – “Mathematics to be properly taught and understood by the learners.”

More recently, it has widely been recognized that in education, Information and Communication Technology (ICT) holds the promise of transforming learning in new and powerful ways. This is the case as it allows for a wide range of people to access the content needed to improve their
knowledge and professional skills without having to travel distances to a school. Despite socio-economic problems in recent years such as poor National economic performances, weak internal management systems, inappropriate governing structures, and low infrastructure, many institutions of higher learning in sub-Saharan Africa have attempted to exploit opportunities offered by ICT in teaching and learning. These opportunities have been exploited at all levels, from primary to higher education.

**Prospects of Mathematics Education in Nigeria**

Mathematics is an exciting and challenging subject which continues to develop at a rapid rate across many research areas. It has a natural elegance and beauty. Taking a real world problem and creating and applying mathematical models to aid understanding is often hugely satisfying and rewarding. Therefore, for our students to enjoy mathematics at school, we must make sure that there are some elements of “good teaching” of mathematics—listening closely to students’ ideas, for example, or being sensitively careful at the interface between mathematical and everyday language—are especially important. They are important in order to recruit students into mathematics, as well as to help them succeed there.

Mathematics today is having an enormous impact on science and society. The influence may be silent and appear hidden but has shaped our world in many ways. Mathematical ideas have helped make possible the revolution in electronics, which has transformed the way we think and live today. The information technology (IT) of today has transformed the world into a global village. These advances in science and technology are made possible by the numerous developments in pure mathematics.

Mathematics is a universal part of human culture. It is the tool and language of commerce, engineering and other sciences – physics, computing, biology etc. It helps us recognize patterns and to understand the world around us. Mathematics plays a vital, often unseen, role in many aspects of modern life, for example:

1. Space travel,
2. Safeguarding credit card details on the internet,
3. Stemming the spread of epidemics,
4. Predicting stock market prices,
5. Business decision making. E. t. c.

As society becomes more technically dependent, there will be an increasing requirement for people with a high level of mathematical training. Analytical and quantitative skills are sought by a wide range of employers. A degree in mathematics provides you with a broad range of skills in problem solving, logical reasoning and flexible thinking. This leads to careers that are exciting, challenging and diverse in nature. Whatever the career plans of our students may be, or if they have no plans at present, a degree in mathematics provides them with particularly good job prospects. To this end, students need to be encouraged to see and know the importance of mathematics in our national development.

In view of this fact, quality teaching personnel should be employed to teach the subject. The government policy on recruitment that has been widely criticized and described as abysmal and politically motivated should be dropped while qualified and competent hands should be engaged to salvage the situation.

The prospects of mathematics education will be brighter when the subject teachers’ mastery of the subject matter is looked upon. Mathematics teachers should be aware of the fact that “memorization method of teaching mathematics” has no place any longer in
the 21st century, this should be replaced with a better method which must be students’ centred and friendly; this will unveil the reality of mathematical concepts to the learners.

The above will also be a reality when the curriculum planners and developers, in all stages of planning, involve mathematics teachers adequately since they are the ones to implement the contents of the curriculum. This calls for the administrators to regularly organize capacity building workshops and professional development seminars to expose them to techniques of teaching difficult topics/concepts in mathematics.

The general maxim is “if education is expensive, try ignorance” – truly, education is expensive, this is the more reason why budgetary allocation to educational sector should be improved upon by the government, while private sector participation in mathematics education programmes should be encouraged.

Notwithstanding, government alone cannot achieve this lofty ideal of effective mathematics education without the full cooperation of the society; the society should lay emphasis on hard work and dignity of labour. “Paper qualification” at all cost, which promotes examination malpractices, should be de-emphasized. Parents will also brighten the prospect of success in mathematics in their wards and society at large, by using positive words to encourage them in the study of the subject, and also by providing them with computers, games, toys that aid mathematics activities.

**Information and Communication Technology (ICT)**

In the past decades, Information and Communication Technology (ICT) have provided societies with vast array of new communication capabilities. ICT is no doubt the most rapidly growing technology. ICT has being defined as “a broad based technology (including its methods, management and application) that supports the creation, storage, manipulation and communication of information” (French, 1996). According to Ibrahim I. Ahmed (2011) ICT refers "to all form of technology applied to acquiring, processing, storing/preservation and transmission of knowledge and information in electronic forms". However, the definition of French is more encompassing than that of Nworgu (2007), which was limited to information processing and did not extend to communication in ICT. The term in its modern sense first appeared in a 1958 article published in the Harvard Business Review, in which authors Leavitt and Whistlers commented that the new technology does not yet have a single established name. We shall call it information technology (IT).” Some of the modern and emerging fields of Information technology are next generation web technologies, Bioinformatics, cloud computing, global information systems, large scale knowledge, and so on. (Haruna & Hassan, 2017). Then recently it was thought that the communication component ought to be highlighted because of its significance. It was then that the concept transformed to Information and Communication Technology ICT (Olusany and Oleyede, 2003). ICT is similar to Information Technology, but focuses primarily on communication technologies. This includes Internet, wireless networks, cell phones and other communication media.

**Information and Communication Technology (ICT) in Nigeria**

The necessity for a national ICT policy become obvious after the participation of the Nigerian delegation to the first African Development Forum on the challenges to Africa of Globalization in the information age held in Addis Ababa in October 1999. As a result, a national workshop on the National Information and
Communication Infrastructure was held in Abuja in March 2000. In the same manner, professional bodies including the Computer Association of Nigeria (COARN), the Information Technology (Industries) Association of Nigeria (ISPIN) submitted draft ICT policy proposals. More efforts followed and culminated in the production of a master plan for the development of a national ICT programme "ICT 2000". In March 2001, the Nigerian National Policy for Information Communication Technology (ICT) was published (Haruna & Hassan, 2017). As a result of this an agency called the National Information Technology Development Agency (NITDA) was later established in April 2001. It is charged with the responsibility of implementing this policy that seeks to make Nigeria an ICT capable nation as well as promote the healthy growth and development of the IT industry (Isoun, 2003).

In the recent years, the Federal Government of Nigeria has Ministry of Communication Technology (MCT). The decision was taken in order to bridge the digital divide between Nigeria and the rest of the world and thereby checking the poor Global Development Index (GDI) ranking of the country. Additionally, the new Ministry would be expected to cushion the developmental effect of the country's Information and Communication Technology (ICT) sector. ICT professionals perform a variety of functions that ranges from installing applications to designing complex computer networks and information databases. A few of the duties that ICT professionals perform may include data management, networking, engineering, database and software design, as well as management and administration of entire systems. Information technology spreads further than the conventional personal computer and network technologies, and more into integrations of other technologies such as the use of cell phones, televisions, automobiles, and more, which is increasing the demand for such jobs (Olawale, 2012).

The Prospects of ICT' in Mathematics Education

The prospect of deploying ICT tools in mathematics education by far out-weights the challenges being faced by it. Thus having enunciated some of the challenges confronting mathematics education in our society our task now is to identify in what ways ICT can help us meet those challenges (Chiadika et al, 2011).

1. With ICT, information on curriculum matters can be stored and accessed at touch button speed which will enable collaborations with institution and industries alike. This will leads to improved exchange of information, and encourage research in curriculum matters. Also curriculum records and documents can be more easily handled, updated, retrieved and forwarded as may be required in e-form.

2. ICT can be used to model Mathematical concepts and systems in order to develop and encourage the understanding and the development of Mathematics Education.

3. ICT can also be used to capture and explore experimental data. In this regard, data-loggers may be used to collect data and using charting tools in Ms Excel, Matlab, and SPSS; graphs can be plotted to display distributions and patterns; and compare various performance scenarios of scientific systems. For example, data-loggers may be used to collect data on animal and crop science related courses and research while data loggers are used for energy audit and management projects and could be used in data manipulation for physics and mathematical modeling. Furthermore, personal computers coupled with appropriate transducers and actuators could be used as measuring instruments such as
oscilloscope, voltmeter, spectrum analyzer, and function generator.

4. ICT can also be used to calculate and solve mathematical problems. In this regard, computer packages such as MS Excel, Maple, Mathematical and MathCAD may be used. In some cases, special programs can be written in C/C++, PASCAL, and BASIC to solve Scientific and Engineering problems. ICT can equally be used to develop software both as part of a course or for use at institutional level.

Challenges Facing the Effective Integration of ICT into Mathematics Education

Before any ICT tool can be deployed, certain infrastructures have to be put in place and the environment created for the fruitful deployment of such assets. The effective development of ICT tools within the entire educational sector in Nigeria is frustrated due to:

1. Lack of adequate ICT infrastructure including: -Low Telephone Density Inadequate supply of Computers Irregular power supply Inadequate Structured Cabling (Backbone & WAN, LAN) Poor teacher preparation and training for mastering and deploying ICT tools. Lack of Adaptation of existing visualization technologies (software based) Poor Deployment of new visualization technologies (software based). Inadequate Deployment of Course ware Poor Networking of resources, insufficient Human resources (Lectures, demonstrators etc.) Inadequate Material resources (Library; holdings etc.).

2. Also higher institutions have not formulated a policy on ICT and the implication of this is that most networks have evolved in an ad-hoc manner without coordination, making sharing of information and resources very difficult. In addition, there is lack of properly documented inventory for ICT resources at educational institutions. This makes sharing of resources and experiences of success stories on the use of ICT very difficult. • Higher institutions have equally very limited bandwidth affecting Internet connectivity. In some cases, the limitation of bandwidth is due to the fact that the channel capacities available are not enough, where as in some cases it is due to bottlenecks caused by viruses and Spam. Coupled with limited bandwidth, there is limited number of workstations and peripherals, and powerful servers to support the demands of ICT within higher institutions.

3. There is also lack of integrated education management information system for use in tertiary institutions in the country in general. This makes it difficult to share information and resources. Furthermore, acquisition of proprietary software is very expensive as each institution does it separately. A plausible solution could be the use of open source; however, most people have a feeling that the quality of open source may not be comparable to proprietary software.

Conclusion

Prior to 1999, ICT was virtually not in existence in the country. In this information age, most developing economies have accepted the fact that ICT is one of the major tools needed to meet up with already emerged economies. ICT is the engine of the 21st century and beyond as it will chart the economic, religious, cultural, legal and social life of nations, particularly that of developing countries (Ukoje, 2004). Also education and indeed, mathematics is one of the pillar of growth and certainly the strongest pillar in eradicating poverty and uplifting the standard of living in any nation. Thus the use of ICT for education and mathematics
education in particular is more critical today than ever before since new means of improving instructional methods are triggering a change in the delivery of education. This paper discussed the challenges facing mathematics education in Nigeria and the ways that ICT can help in confronting and solve them. Even though the implementation of ICT tools are also faced with some constraints, the writer opine that the prospect deploying ICT tools in mathematics education outweighs the challenges.

Recommendations
1. Highly qualified and competent mathematics teachers should be employed and current euphemism of “man knows man” should be discouraged as regard recruitment and appointment.
2. Teacher training institutions should put up programmes and incentives to encourage many students to read and study mathematics using ICT tools.
3. Regular capacity-building, ICT workshops and professional development programmes for mathematics teachers should be organized.
4. Wages and salaries of mathematics teachers should be improved upon; this becomes necessary because of the tasking and demanding nature of teaching mathematics with ICT.
5. The UNESCO declaration of twenty-six percent (26%) budgetary allocation to the education sector and invariably to mathematics education, should be given accelerated implementation by the government.

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Information and Communication Technology in Service of Education.


