International Journal of Innovation and Research in Educational Sciences
Volume 5, Issue 6, ISSN (Online) : 2349–5219

Information and Communication Technology (ICT) and 21ST Century Education in Nigeria

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Date of publication (dd/mm/yyyy): 20/11/2018

Abstract **– The paper describes Information and Communication Technology (ICT) in education as a vendor of high efficiency, high productivity, and high educational outcomes, including the quality of cognitive, creative and innovative thinking. The advantages of applying ICT in teaching and learning have not only led to expansion of learning opportunities thereby making education accessible to much more participants than erstwhile, but have also facilitated advancing knowledge and skills necessary for effective functioning in the modern world. Besides portraying the various ways in which the use of ICT affects teaching and learning, thereby making ICT central to education in the 21st century, the paper discusses the "knowledge maps" that reveal what is known about the benefits of ICTs to education, including contrivances that transform conve- - ntional classroom situations into digital forms that make them more exciting and intellectually challenging. Special attention was given to ICT-based technology for teacher education in the 21st century while proffered recommendations highlight the prospects of overcoming the obstacles confronting the successful use of ICT in Nigerian secondary schools.**

Keywords **– Creative and Innovative Thinking, Knowledge Maps, Digital, ICT-based Technology, Technology in Education and Technology of Education.**

I. INTRODUCTION

Information and Communication Technology (ICT) in education has been continuously linked to higher efficiency, higher productivity, and higher educational outcomes, including the quality of cognitive, creative and innovative thinking. In response to the global imperative of education for all, and not willing to be left at the lower side of 'digital divide' Nigeria launched the Universal Basic Education programme in 1999 and also developed an ICT policy in 2001. One of the objectives of the policy focused on integrating ICT into the mainstream of education and training, including basic education. This has been evolving through a number of private and donor-funded initiatives though there is the need to ensure effective and sustained use of ICT in mainstream formal education system. This paper explores Nigeria's ICT in education in the 21st century, the availability of ICT tools in schools, teachers' competence and the prospects of ICT at the basic education level, and the relevance of ICT towards enhancing teaching and learning in the 21st century Nigerian school system.

The educational system in Nigeria has been delineated into different levels mainly pre-primary, primary, secondary and tertiary levels [1]. The increasing development of the educational system at all levels brings greater demands on educational practitioners such as curriculum planners, evaluators and teachers particularly in their bid to move along with the information technology of the 21st century. As the world changes steadily, information and knowledge also change rapidly. In response, educational technology, encompassing *instructional theory* and *learning theory* and implicating teaching and learning processes as well as the management of schools are bound to change as well. Hyer cited in [2] dichotomized educational technology into two levels, namely: *technology in education* and *technology of education*. Technology in education has to do with the use of ICT in educating students. It is often referred to as Instructional technology implying the orderly process of utilizing all foreseeable means of managing and improving the teaching-learning process support- - ed with various audio-visual aids and instructional media so as to ensure effective and efficient learning. Technology of education, on the other hand, refers to the systematic approach to educational technology based on clearly stated objectives. In this case, we can distinguish three approaches:

a. *The Hardware Approach* implying the use of machines, tools, equipment and gadgets to simplify learning. This approach involves the application of automation to make teaching more interesting, more exciting and sometimes more challenging.
b. *The Software Approach* referring to the process of using instructional package such as programmed instruction to influence learning.
c. *The System Approach* which considers teaching and learning as a structured holistic process of enabling and aiding learners to discover and solve their educational problems. The approach is based on analyzing instruction into component processes and integrating them into an organized whole for the attainment of specified objectives.

II. ICTS AND EDUCATION IN THE 21ST CENTURY

The use of ICT can improve education quality, expand learning opportunities and make education accessible. It is as a result of these advantages that Nigerian educational reforms stressed the use of computer technology in schools during the 32nd ministerial session of the National Council on Education meeting of 1987. One major policy in enhancing the deployment of information and communication in Nigeria was the Nigerian National Policy on the adoption of ICT in schools. ICT is the emergence of tools of micro-electronics and telecommunications that are used in the automatic acquisition, analysis, storage, retrieval, manipulation, management, control, movement, display, transmissi-

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-on, reception, and interchange of quantitative and qualitative data [3]. [4] Divided ICT in education into three categories: instruments (TV, DVD, computer), instructional (video and multimedia modules) and dissemination (TV broadcast, CD or Web), but emphasized that the choice of technology and the way it is used is partially determined by what is expected in terms of education, learning and teaching objectives. It emphasized that the prominent role of information and communication technology could be seen in advancing knowledge and skills necessary for effective functioning in the modern world. ICTs have become key tools with a revolutionary impact on educational inputs and procedures. Today, admission exercises into some public educational institutions are conducted online; hence the place of ICTs in education cannot be underestimated.

III. Impact of ICT on Teaching and Learning

ICT affects teaching and learning in the following specific ways:

i It provides a more scientific basis for designing instruction in a sequential manner and utilizing adequate instructional materials and other reinfor--cement strategies.

ii It makes instruction richer and more powerful in influencing learning through the application of new forms of communication and technology by which distant and remote events can be brought close into the learning situation, e.g. use of films (motion pictures), slides, photographs and film-strips.

iii ICT supports the delivery of educational resourc--es, particularly course materials ranging from printed books and charts through radio and television to multimedia computers and internet.

iv ICT makes education to become more productive by speeding up learning and enabling students to invest more time in the application of acquired knowledge and creativity which can lead to breakthroughs.

v It simplifies the task of the teacher in communicating abstract concepts to learners by helping to bridge the gap between theory and practice. Learners can study reality through computer simulation and the use of various media that are capable of bringing the world into the classroom.

vi Today, the emphasis on technology has led to broadening of the academic curricula to include legitimate courses in vocational areas such as home economics, journalism, accountancy, photo--graphy, environmental design, animal husbandry, television and broadcasting, engineering, electro--nics and puppetry.

vii ICT has further led to individualized instruction thereby enabling learners to proceed at their own rates through the use of programmed instruction, learning packages and computer terminals.

viii Besides improved access and equity in education by influencing open and distance learning, ICT has made it possible for instruction to be brought to individual homes through radio and T.V. broadcasts and through the internet. Even the handicapped and children with special learning problems could be provided with diversified learning environment employing appropriate technological devices that enable them to develop their potentials. For instance, Braille for the visually impaired learner is an outcome of innovation in technology.

IV. ICT in Nigerian Education

In Nigeria, it is necessary to use ICTs to make education more relevant, responsible and effective not only for the school setting but also for lifelong learning. To compete successfully in a competitive global economic environment, a highly skilled and educated workforce with aptitude and skills in the application of ICT is very essential. This makes knowledge and use of ICT central to education in the 21st century [5]. People need to be effective and efficient in the use of ICT for success in today's rapidly changing and highly competitive globalised world that depends very much on knowledge economy and skills. [6] Encourages all stakeholders in education in Nigeria to be concerned about how best to take advantage of the knowledge economy. Extrapolating on this wise counsel, [7] posited that:

Beyond the immediate educational goal is the question of how to provide the 'best education' to form the next generation of competent leaders from community to the national and global levels, economic planners, scientists, artists, humanists and more generally informed citizens, especially in this fast-paced, technology-prone and globalized world.

Application of ICTs in teaching and learning include radio lessons, TV broadcast lessons, computer -assisted instruction (CAI), distance learning, video conferencing, management information systems, stock taking and simulations. In all of these applications, communication is involved whether or not the learner is in visual contact with the source of information. [8] In its 'Information Development program' created a series of 'Knowledge Maps' of what is known (and what isn't known) about ICT use in education. One of these maps that revealed what is known about the benefits of ICTs to education led to the following conclusions:

i. *The Internet is not widely available in most less developed countries; radio and TV are* **-** Radio and TV broadcasts have greater penetration than the Internet throughout much of the developing world, and the substantial gap is not expected to be closed soon.

ii. *Radio and TV can have high start-up costs, and reinforce existing pedagogical styles* – however once installed, the running and maintenance costs are much lower. The only snag is that radio and

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TV broadcasts are seen as less 'revolutionary' ICTs in education because of their linkage with instructor-centric models, unlike computers that foster more learner-centric instructional models.

iii. *Radio instruction has been used widely and is reasonably well studied* – Radio instruction in combination with school-based educational resources is common and popular. The National Mass Education Commission (NMEC) with the support of UNESCO has embarked on pushing back the frontiers of illiteracy in Nigeria through radio lessons particularly because of the special advantage of radios in reaching rural and remote corners of the country.

iv. *TV has been used with success in a few places* – e. g. in Latin America and China as a mechanism for reaching out-of-school youth. In Nigeria, the National Open University of Nigeria (NOUN) is expected to rely substantially on TV broadcasts for delivering distance learning materials to its students. This expectation is not being realised anyway.

v. *It is unclear where to place computers to make sure they are used most efficiently* – The idea of Computer-Aided Instruction as replacements for teachers has been discredited by experts. New Internet technologies which must rely on computers hold promise for providing connectivi--ty to remote areas but are yet to become operational.

vi. *Mobile Internet Centres (vans, etc.) are being developed as a way to reach rural areas* – In Nigeria, the cost of its acquisition and the operational bottle-necks may not be justified by the anticipated impact. The abandonment of 'School-on-the-Wheel Project' in Nigeria for nomadic education in the 1980's is reference point on what may befall such an investment.

vii. *Community Telecentres (sometimes based in schools) are a hot topic, but successful models have not yet emerged* – Such tools will provide wide access to teachers and students alike to ICTs outside the formal school settings.

viii. *The use of handheld devices is receiving widespread attention* – Although little research has been done on the use of handheld devices such as personal digital assistants and mobile phones in education, yet they are becoming very popular especially in Nigeria.

One thing that stands out clearly from the foregoing analysis is that ICTs offer opportunities for dynamism in the application of teachers' creative imagination. Contrivances used in conventional classroom situatio-ns can now be transformed into digital forms to make them more exciting and intellectually challenging teaching aids. For instance, [9] developed an educational simulation termed 'Countryman's Water' for the study of the processes and interactions involved in providing portable water supply to a rural community under Environmental Education. However, [10] digitized the ideas in Countryman's Water into a computer simulation thereby making it possible for individual learners to acquire the relevant information and knowledge interacting with the computer. It is noted that in a normal classroom devoid of ICT tools, the simulation will be carried out by learners acting out the various roles with the possibility of sabotage, collapse or disaster the occurrence of which are minimized if ICTs are in use.

V. Advantages of ICTS in Education

Just like ICT has impacted on virtually every sector of humanity, it has also helped in re-engineering and repositioning education through various modern tools and techniques. The following advantages are obvious even in a country where digital divide is still common.

1. *Active Learning Techniques* - One great advantage in the application of ICTs in the teaching-learning process is that the various tools encourage active learning or maximum learner participation in the lesson.
2. *Simulation, Modelling & Animation* - Simulation refers to the reproduction of essential features of something, e.g. as an aid to study or training. The computer game is a simulation or an attempt to represent a real activity such as soccer or flying. We can also use simulation in the form of diagrammatic model to reflect the characteristics of a phenomenon, system, or process, often using a computer, in order to infer information or solve problems. *Animation* is the production of moving images by computer techniques, or the image produced.
3. *E-Mails (electronic mails)* - The information flow in the form of computer - to - computer communication is described as e-mail. It is a system that allows text-based messages to be exchanged electronically, e.g. between computers or cell phones. A communication sent by e-mail is called message and it is possible under distance learning system for a lecturer to send instruction to students through e-mail.
4. *Computer-Based Instruction /Learning* - The computer can serve as a teaching machine to deliver programmed instruction to learners. For instance, this could be adopted for regular instruction from pre-primary to university level in conjunction with text books, lectures, films and discussion; for enrichment of curriculum especia--lly for students who want to pursue their interests outside scheduled class lessons; and for remedial instruction especially with slow learners who need corrective training.
5. *Electronic Learning (e-learning)* - This is the acquisition of knowledge and skill using electronic technologies such as computer and Internet-based courseware and local and wide area networks.
6. *Educational Networks* - The whole world is inde--ed engrossed in what has been described as the information age in which computerization has become the order of the day. It is expected that if

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we belong to this information age, then we must all be computer literate in order to exploit the benefits of educational networks. Through this, information could be shared among institutions that are far distant apart. Examples include the EDUNet, Schoolnet Nigeria, NUNet (NUC & Universities), OAUNet, NCCENet (Teachers Portal), Schoolnet of various African countries especially those of Gambia, Mozambique, Uganda, Kenya, Angola and South Africa etc.

7. *Special Interactive Guidance Information (SIGI)* - Teachers can organize special guidance and counseling services system through educational network. This implies that students could secure help from their teachers without physical contact with them.
8. *Chat/ Communication* - This includes teleconfe- -rences and video conferences by which persons within a country could confer with professional colleagues or development partners in other countries. For instance, a discussion of approach- -es to in-service teacher education could be held between policy makers in education in Nigeria and lecturers at the New York State University in America and others at the University of Lesotho in Roma or perhaps the University of Toronto in Canada.
9. *Administrative Applications in Schools* - These include using computers to prepare school plans, time tabling, forecasting, graphical representatio- -ns and the management of educational resources including database. When data are systematically collected and arranged in the computer, they can be manipulated for different purposes and retrieval is automatic. Spectacularly, the records that are so kept will be empirically meaningful, professiona- -lly realistic, sequentially and successively more manageable as well as being richly informative.

VI. ICT AND THE TEACHER IN THE 21ST CENTURY EDUCATION

The pervasiveness of ICT has brought about rapid teleological, social, political and economic transforma- -tion, which has eventuated into a network society organized around ICT [11]. For instance, e-learning is becoming one of the most common means of using ICT to provide education to students both on and off campus by means of teaching online offered via web-based systems. Looking at the role of education in nation building and the population explosion in the secondary schools nowadays, the use of ICT in the teaching-learning process becomes imperative. Such issues like good course organization, effective class management, content creation, self-assessment, self-study, collaborative learning, task-oriented activities, and effective communication between the actors of teaching-learning process and research activities will be enhanced by the use of ICT-based technology. Indeed, the process of teaching and learning has gone beyond the teacher standing in front of a group of pupils and disseminating information to them without the students' adequate participation [12]. With the aid of ICT, teachers can take students beyond traditional limits, ensure their adequate participation in teaching and learning process and create vital environments for learners to experiment and explore.

However, a cursory look at the secondary schools in Nigeria shows that many teachers in the system still rely much on the traditional "chalk and talk" method of teaching rather than embracing the use of ICT. [13] Observed that the computer is not part of classroom technology in over 90% of public schools in Nigeria, hence, the chalkboard and textbooks continue to dominate classroom activities. The various ICT facilities used in the teaching learning process in schools include radio, television, computers, overhead projectors, tape recorders, fax machines, CD-Rom, Internet, electronic notice board, slides, digital multimedia, video/ VCD machine and so on [14], [15], [16]. Unfortunately, most of these facilities are not sufficiently provided for teaching–learning process in the Nigerian secondary schools. This might account for why teachers are not making use of them in their teaching. Therefore, in the 21st century, teachers need to be in tune with the use of ICT in classrooms.

VII. OBSTACLES TO THE USE OF ICT IN SECONDARY SCHOOLS IN NIGERIA

Challenges include improvements to basic educational infrastructure and ICT infrastructure; availability of quality teachers to apply ICT to the existing education systems; bringing long-term, sustainable ICTE reform through local, national, and regional government bodies; making difficult decisions in how to allocate national monetary resources and foreign aid; and shifting the existing focus from the traditional educational models in place, depending on the specific country, to one that is ICT-driven [17].

There are several impediments to the successful use of information and communication technology in secondary schools in Nigeria. These are: cost, weak infrastructure, lack of skills, lack of relevant software and limited access to the Internet.

Cost –

The price of computer hardware and software prohibits liberal access to possession of personal computers. Nigeria has over 6,000 public secondary schools majority of which operate from dilapidated infrastructure such as classrooms and only a few are equipped with laboratories and libraries. Apart from the costs of basic computers themselves, there are associated costs of the peripherals such as printers, monitors, paper, modem and extra disk drives which are beyond the reach of most secondary schools in Nigeria. Of course, many secondary schools would find it hard pay the exorbitant Internet connection fees.

Weak Infrastructure –

In Nigeria, infrastructure deficiencies constitute a formidable obstacle to the use of ICT. ICT services can only function under "controlled conditions" governed

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electricity supply. The epileptic supply of electric power in Nigeria over the past two decades does not provide an enabling environment for serious ICT applications.

Lack of Skills -

Nigeria does not only lack information infrastructu--re, it also lacks the human skills and knowledge to fully integrate ICT into secondary education. There is acute shortage of trained personnel in application software, operating systems, network administration and local technicians to service and repair computer facilities. To use ICTs profitably in Nigerian secondary schools, there is the need for locally-trained technicians to install, maintain and support the systems. Besides, most secondary school teachers in Nigeria lack the skills to fully utilize technology in curriculum implementation. [18] Through a survey research, affirmed that teachers of Federal Unity Colleges in North-Central geo-political zone of Nigeria are not competent in the use of ICT.

Lack of Relevant Software –

Software that is appropriate and culturally suitable to the Nigerian education system is in short supply. Furthermore, there is a great discrepancy between relevant software supply and demand in Nigeria.

Limited Access to the Internet –

The greatest technological challenge in Nigeria is how to establish reliable cost-effective Internet connectivity. The few available Internet providers consist of Nigerians in partnership with foreign information and communication companies. Many of these companies provide poor services to customers who are often exploited and defrauded. The few reputable companies, which render reliable services, charged high fees thus limiting access to the use of the Internet.

In summary, though ICTs are quite attractive, yet there are limitations to their full utilization in contemporary Nigeria. One of the challenging problems as identified by [19] is shortage of qualified teachers that specialised in ICT, particularly at the primary and secondary school levels. For tertiary institutions, there are graduates that specialised in computer science and related ICT areas but the same cannot be said about staff in basic and post basic schools in Nigeria. There is also the problem of high cost of producing specialized instructional materials in response to the dynamism that is associated with ICT applications (e.g. word-processing, Internet usage, networking, e-mail, and multi-media). Other major drawbacks in the implementation of ICTs in Nigerian schools include: prohibitive cost of software, low computer literacy rate, communication and collaboration barriers, and criminal or fraudulent use of ICT facilities (e.g. internet fraud and use of GSM to perpetrate examination malpractice).

VIII. Conclusion

In view of the current state of ICT in secondary schools in Nigeria, it can be concluded that the integration of ICT in Nigerian education in the 21st century leaves much to be desired. However, prospects abound considering the efforts of govern- -ment particularly towards the provision of ICT facilities and the training and retraining of teachers. Major government policies if properly implemented would position the country's educational system on an ICT pedestal capable of transforming the education sector to become comparable globally. Already the Joint Admissions and Matriculation Board and some universities have started experimenting on the use of computer based tests for high-stake examinations. This effort is bound to revolutionize assessment practices in Nigeria education.

Recommendations

There are numerous and good prospects for the use of ICT in teaching and learning in secondary schools in Nigeria if the following recommendations are adhered to:

1. Teachers should use the computer to enhance educational efficiency especially in the handling large classes of students. This presupposes that teachers must possess the skill of using digital projectors and produced slides for teaching.
2. Teachers can also use the computer to enhance problem-solving skills of the learners by focusing on thinking skills especially in subject such as mathematics.
3. School heads should insist on using computers for administrative functions such as replacing the laborious exercise of filing papers in filing cabinets and shelves, assisting in budget planning, accounting for expenditure, writing correspondenc--es and reports, assigning students to classes, reporting students' progress and testing students and scoring tests which help to reduce paper work.
4. Teacher education institutions should endeavor to introduce student-teachers to how computers could play the role of the tutor and present the learner with a variety of contents and symbolic modes. Thus, ICTs can be utilized for individualized learning in secondary schools in Nigeria.

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