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The Role of Information and Communication Technologies (ICT) in the Teaching and Learning of Science in the 21st Century

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Abstract
The role of ICT for teaching and learning has become so important as it foster better teaching and learning, creating a conducive environment for the learners. ICT in education is becoming more and more important and its growing more and more even at this 21st century. This paper therefore examines the role of information and communication technology in the teaching and learning of science in the senior secondary school in the 21st century with emphasis on the prospects and challenges of ICTs in our schools in this 21st century. The paper also examines the concept and Relevance of science in the school curriculum. The paper concludes that the advantages of ICTs outshine the disadvantages and therefore, since it can bring positive outcome and can be used to address educational challenges being faced by teachers and students of science in the 21st century and ensure quality education then ICT should be embedded into the curriculum at all levels i.e. Primary, Secondary and Tertiary Institution.

Keywords*: Information communication technology (ICT) Curriculum, teaching, learning.*

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I. INTRODUCTION

Information and communications technology is an extended term for information technology (IT) which emphasis the role of unified communications and the integration of telecommunications (telephone lines and wireless signals) computers, as well as necessary software. Its storage and the audio visual systems and other communication technologies including the internet, software, middleware, video conferencing, social networking and other media applications and services. Ezekoye (2005) stated that the development of e-learning product and the provision of e-learning opportunities is one of the most rapidly expanding areas of education and training. ICT technology is required for information processing in particular the use of electronic Computers, communication devices and software, applications to converts, store, protect, process, transmit and retrieve information from anywhere at any time. It is a technology that provide access to information through telecommunicating which include the internet, wireless networks, cell phones and other communication mediums. Each of the different ICTs –print audio/video cassettes, radio and TV boradcasis, computers or the internet may be used for presentation and demonstration in science classes.

The components of an ICT system include The Data which is the raw facts and figures, the hardware that is the physical components, the software, which is the name given to computer programme, we have also the information which is the data that is converted to given it a meaning and the procedures which is the series of actions conducted in a certain order to make sure the system runs smoothly.

Information and communication technology has been a force that has changed many aspects of human endeavours. According to Daniels (2002), ICTs have become within a very short time, one of the basic building block of modern society it has led to position impact in the field of education in most developed countries. The impact of ICT on various fields of human endevours such as medicine, tourism, business, baking, engineering, architecture over two or three decades has been enormous. Jajau (2006) stated that one of the recent drives of the society towards making education relevant is making information and communication technology a common feature of the education process but when one looks at the field of education according to Adesote & Fatoki (2013) there seems to have been an uncaring lack of influence of ICT and for less change than other fields have

experienced, however presently ICT has begun to have impact gradually in the field of education, its impact has not been as significant as in other fields.

Education according to Adesote & Fatoki (2013) is socially oriented activity and quality education has traditionally been associated with strong teachers having high degrees of personal contact with learners and with the world moving rapidly into digital media and information. There is also the need to develop digital teachers that will produce the kind of graduates and citizens required in a digital society, improve educational outcomes and enhance and improve the quality of teaching and learning. In line with this is the taught of Garrison and Anderson (2003) argued that the application of ICTs in the teaching and learning process can enhance the quality of education in several ways such as increasing learner motivation and engagement, facilitating the acquisition of basic skills, and enhancing teachers training.

According to lankshear, snyder & Green (2000) talks about workability principle, that technology can be developed to solve problems association with human need in more productive ways, he said if there is no problem to solve, the technology may not be developed and /or not adopted applying this principle to education would be that education institution should create and adopt technologies that address educational problems of which there are many which means when discussing applications of computer technology to education the question must always be asked, what educational problem needs to be addressed and be asked at all levels of decision making.

Concepts and relevance of science in the school curriculum

Science allows students to explore the world and discover new things. It is also an active subject containing activities such as hands on labs and experiments, this allows students to be acquitted to the subjects and it can also be seen as an important part of the foundation for education for all students. This is because directly or indirectly it plays an essential role in attempting to tackle the major human and socio-economic problems in addition to making the society more scientifically literate. This is reaffirmed by the notion that science is a requirement for studying such courses as medicine pharmacy engineering, nursing, among other courses.

Many students fear and shy away from this subjects –chemistry, physics, biology, Mathematics, most especially mathematics, physics and chemistry because students believed that they are difficult subjects. According to Ezeliora (2009) stated that the reason why chemistry is perceived as difficult and abstract is the way it is being presented to students. This can be made less abstract and more interesting to learners by the method adopted by teachers and one of the such method is application of information and communication technology (ICT) devices in the teaching and learning of science subjects.

Oliver (2000) stated that conventional teaching has emphasized content and courses have been written around textbooks. Teachers have taught through lectures and presentation interpersed with tutorials and learning activities designed to consolidate and rehearse the content. Contemporary setting according to him are now favouring curricular that promote competency and performance, emphasizing capabilities and be concerned about how information will be used than with what information is, hence there is competencies and performance based curricula because of the use of this technologies. The science curriculum aim to help children develop basic scientific ideas and understanding about the biological and physical aspects of the world, and the processes through which they develop this knowledge and understanding through this, students create new knowledge and learn about scientific principles. We are surrounded by Technology and the products of science everyday, hence students must be scientifically literate to succeed, therefore teaching the scientific method to students is teaching them how to think, learn, solve problem and make informed decisions. These skills are integrated from the curriculum into every aspect of students education and life, from school to their career and into their society.

The aims of the teaching and study of sciences are to encourage and enable students to develop inquiring minds and curiosity about science and the natural world, acquiring knowledge, conceptual understanding and skills to solve problems and make informed decisions in scientific and other contexts. From here, we could see that science enhances critical thinking it cultivates a passion for learning, uplifts many disciplines, holds the key to the future and gives numerous career opportunities.

According to Alice (2019) there are two questions at the heart of the developers of a science curriculum. Which are exactly the purpose of science education and what aspects of science are worth teaching. These are answered in the curriculum materials according to Roblen, Schunn & Mckenney (2017) as resources designed for use by teachers in the classroom to guide their instructions including textbooks, supplementary units or modules and instructional media, because of the unique positions, influence what teachers and students do on a daily basic Brown, (2009) and hence can have a significant impact on both students and teaching and learning.

Many studies also showed that science curriculum materials like ICT can have positive effects on student learning, including gains in students attitude and motivation toward science. In line with White &

Frederiksen (2000) staled that it helps in understanding the key science concepts while Sadler, Romine, Memon, Ferdig & Annetta (2015) stated that it gives good abilities to engage in science practices.

Role of ICT in the teaching and learning of science in the 21st century

Effective teaching and learning of science can be achieved through adequate relevant and effective use of instructional materials that is in vogue in the 21st century and that is the use of information and communication technology (ICT). According to Agbo & Abu (2009), The 21st century has reduced the universe and its content into a small sphere popularly named global village and this has therefore evolved an era of global computations and has resulted in a shift from standing alone information dissemination to network distribution of information to anybody, anywhere and anytime.

ICT in the 21st century has the potential to accelerate, enrich and deepen the skills of the learners and even the teachers, it can motivate and engage students to help relate school experience to work practices, create economic viability for tomorrow workers, as well as strengthening teaching and helping schools change.

Curricular support should be made available in science subject areas, this will help to improve and develop the quality of education in sciences and the integration, of information and communication technologies can be to revitalize teachers and students in this area. According to Zhao & Cziko (2001) teachers need to be involved in collaborative projects and development of intervention change strategies in which three conditions are necessary for teachers to introduce ICT into their classrooms. According to him, teachers should believe on the effectiveness of technology, teachers should believe that the use of technology will not cause any disturbances and teachers should also believe that they have control over technology (Cziko, 2001).

According to Balanskat, Blamire & Kefala (2006), ICT is to enable teachers to save time and increase productivity in such activities as;

- Access to a variety of information, sources forms and types.
- preparing and updating daily lessons
- plans, making bard copy visuals at times and handouts for classes as well as individualized educational plans for slower students and students with disabilities or with special problems.
- presenting visual/oral content materials tasks, and questions to the audience
- maintaining grade books
- compiling a data bank of exam questions
- online inspection and correction of students work on their computers keeping records, chronides and archives of all the above mentioned events and proceedings with fast retrieval and easy access to any entry.

ICT has three positions in the curriculum and these include learning about ICT, learning with ICT and learning through ICT. Learning about ICT refers to ICT concept as a subject of learning in the school curriculum while learning with ICT is concerned with the use of ICT as a medium to facilitate instruction (Akindolu, 2007).

ICT can be integrated into the learning process such as the one seen in blended learning so that learning takes place through the learner's interaction with the facilities because it can be considered as discipline, resource and key skill in education; This idea is in line with law (2003) that learning through ICT refers to the integration of ICT as an essential tool into a course/ curriculum, such that the teaching and learning of that course/curriculum is no longer possible without it.

Young, (2002) one of the most vital role of ICT in the field of education is easy access to learning, students can now brows through e-books, have easy access to resources persons, mentors, experts, researchers, professionals and peers all over the world and that this flexibility has heightened the availability of just-in-time learning and provided learning opportunities for many more learners who previously were constrained by other commitments.

ICT has the potential to remove the barriers that are causing the problems of low rate of science education in any country, it can be used as a tool to overcome the issues of cost, less number of teachers and poor quality of education as well as to overcome time and distance barriers (McGorry, 2002). It allows for the creation of digital resources like digital libraries where the students, teachers and professionals can access research materials and course materials from any place at anytime, hence networking of academics and scholarly materials are encouraged. ICT eliminate time barriers, geographical barriers as learner can log from any place and it provide speedy dissemination of education to target disadvantaged groups (UNESCO, 2002).

The use of ICT can improve performance, teaching, administration and develop relevant skills in the disadvantaged communities, improves the quality of science education by facilitating learning by doing, real time conversation delayed tune conversation, directed instruction, self learning, problem solving, information seeking and analysis and critical thinking as well as the ability to communicate, collaborate and learn Bottino (2003), Yucn et al (2003), Sharma (2003) This is in line with new media consortium 2007 who said ICT presents and entirely new learning environment for students, requiring different skills set to be successful

critical thinking, research, and evaluation skills are growing as students have increasing volumes of information from variety of sources to sort through.

Sangra & Sanmamed (2010) in their research pointed out that using ICT at schools helps to improve students' attention and perception skills and that ICT offers numerous possibilities to manipulate and stimulate situations, phenomena, actions representing extraordinary education potential for the application of learning.

Jongur, Mohammed & Abba (2008) identified the following teaching strategies which is common to science and the ICT devices that is applicable to the teaching methods.

a. Cooperative learning and small group activities:- the ICT facilities applicable to cooperative learning are use of e-portal, video clips, and interactive radio programmes, here the students are grouped and learning materials structured in such a way that they are interactive and participatory as much as possible to help each member of the group to learn.
b. Individualized instruction in science learning:- ICT facilities includes LCD projector, overhead transparencies, video clips, computers and radio sets. The learning materials is structured in such a way that it can facilitate individual learning
c. Immediate feedback:- in science learning, ICT facilities applicable are projector, overhead transparencies video clips, computer slides/power point facility and projector screen using transparences etc.
d. critical thinking motivation:- the ICT facilities applicable include video conference, E-mail/fax and Phones. Here data can be generated or questions prior to mapping out the theoretical landscape of the concept, secondly students can learn to assess the relative advantage of several approaches that is used in teaching such concept.

ICT such as video, television and multimedia computer software that combine text, sound, and colourful moving images can be used to provide challenging and authentic content that will engage the student in the learning process. The use of sound effects, songs, dramatizations, comic skits and other performance in interactive radio, television computer, and handset compel the students to listen and become more involved and immersed in the lessons being delivered. This is actually making parent and students more motivated than before in the stereotype few minutes lecture; research showed that students loved the digital learning because it is more effective than the monotonous classroom situation of the conventional method hence it allows learners to explore, engage discover and inspire which is the aim and objectives of science teaching rather than merely listening and remembering.

Challenges of ICT in Education

Generally, speaking a number of factors are said to have militated against the use of ICT in education in Nigeria. These include such factors as lack of funding to support the purchase of the technology, lack of training of teachers, lack of motivation on the part of teachers to adopt ICTs as teaching tools in the classroom instruction e.t.c. Cradler (2002) stated that the use of inappropriate hardware, the lack of useful software and the difficulty in gaiming adequate access to computer system were noted as major obstacles to the use of ICT by teachers and students. The choice and distribution of hardware and software are crucial to the success of computer use in schools. Another challenge is the epileptic power supply, inadequate financing of science/technology education. There is also problems of acquisition and/or supply of ICT instructional materials and equipments though its better done now than before.

There is also the problem of continuity in proposals and projects from one government regime to another. Teachers attitude has to be changed because it play important role in the teaching and learning process that utilizes computers and internet connections, this idea is in line with Mikre (2011) teachers attitude towards use of this technology is vital and teachers do not have clarity about how far technology can be beneficial for the facilitation and enhancement of learning. Even though some teachers have positive attitude to the technology but refrain from using it in teaching due to low self efficiency, tendency to consider themselves not qualified to teach with technology.

There is still the problem of teacher resistance and enthusiasm in using ICT due to the fact the teachers do not have the required skills and training needed in using ICT. This made, Brosnan, (2001) stated that unless teachers develop some basic skills and willingness to experiment with students, ICT use in education will be at disadvantage.

Mikre (2011) identify the following limitations of ICT in education as related to student behaviour

- Computers limit students imagination
- ICT limits students critical thinking and analytical skills
- students often have only a superficial understanding of the information they downloaded.
- computer based learning has negative physical side effects such as vision problem.
- students may be easily distracted from the learning and may visit unwanted sites.
- students tuned to neglect learning resources other than the computer and internet

- students may have less opportunity to use oral skills and hand writing
- use of ICT may be difficult for weaker students, because they may have problems with working independently and may need more support from the teacher.

The rural dwellers must be taken into consideration, in terms of connectivity, most especially in the rural areas is very bad, besides parents of these students who lives in rural areas are poor, basically petty traders, farmers etc where most of their children cannot afford smart phones, this and others are the serious challenges in Nigeria where these categories of students meet with their counterpart who are better off from the urban centres.

Also there is the challenge of high cost, virus attack of software, money to buy data by the student, maintenance of facilities, infrastructural challenges. Therefore if these challenges can be overcome, then the educational system will benefit mostly from this technology in this 21st century.

II. CONCLUSION

In this 21st century, it has been seen that the role of ICT in numerable and it is something we cannot do without since we are already in the digital age, society itself is going digital, hence, ICT can enhance and improve the quality of teaching and learning, deepen students content knowledge and support the development of complex thinking skills. The adoption and use of ICTs in education have a positive impact on teaching and learning the impact is growing considerably and becoming a strong agent for change among many educational practices. learners can access their knowledge regardless of time and geographical location. ICT can influence the way students are taught and how they learn and it foster better teaching and improved academic achievement of students.

III. RECOMMENDATION

From this research the following recommendations are made:

- To allow connectivity and access to network, the problem of electricity should be controlled.
- The teachers in our various schools should be trained for ICT with the available devices.
- personnel should be trained in terms of quality and quantity to enhance smooth and continuity of the operation of the devices so that the lifespan will not be short.
- All the technologies (ICTS) products should be made available in schools and teachers and students should have access to them.
- Networks among educational institutes should be created.
- Improving overall standard of education by reducing the gap in quality of education between urban and rural schools
- There should be utilization of ICT (Computer and internet) in education at all levels.
- Education policy maker should recognize and adopt the use of ICT in the curriculum
- The phillantropists in the society can help in the distribution of this devices and infrastructure in the school.
- Parents also has a role to play, by encouraging and supplying all that is needed for the successfully use of ICTs by the wards like providing data and other necessities at home so that there will be continuity from schools to the different homes and then back to school.

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