

ENHANCING THE TEACHING OF SCIENCE THROUGH THE USE OF ICT IN SENIOR SECONDARY SCHOOLS

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Abstract

Information and Communication Technology (ICT) is an important area that cannot be ignored in education because of the demand due to technological growth in both the private and public sectors of the country's economy. Science teachers need to bring their ICT knowledge up to date since ICT tools are considered to be an efficient way to extend the horizons of traditional science teaching. ICT tools can also support learning strategies where students' projects are involved thereby improving and enhancing students' interest. This paper examined the concept of ICT; application of ICT in science education; the benefit of ICT in science teaching and learning; challenges to the use ICT in teaching and learning of science. Some solutions to these problems were also suggested.

Keywords: Information and communication technology, teaching, science education

Introduction

The importance of ICT cannot be over emphasized as it forms the basis for technological advancement of any nation. The knowledge of ICT plays a very significant role in the economic development of any nation hence the need for the subject to be taught very well to enable students to develop interest and improve their achievement in technology. Effective teaching according to Ogu and Ononugbo (2006) is measured by the expected outcome that follows instruction. For effective learning to take place in teaching, two things are imperative; teachers' knowledge and the learner's interaction (Kola, 2013). Explaining further Kola (2013) stated that both the teacher's knowledge and the learner's interaction are each categorized into three. The teacher's knowledge includes the content knowledge, pedagogical knowledge and technological knowledge while the learner's interactions include learner-teacher interactions, learner-learner interaction and learner-environment interaction (KoIa, 2013).

- **Content knowledge:** This involves the science teacher being knowledgeable about science. The science teacher must know about science theories, concepts, principles and laws.
- **Pedagogical knowledge:** This involves the science teacher knowing about the nature of learning, methods of teaching, how to assess students and how to manage the classrooms.
- **Technological knowledge:** This involves the teacher having skills to operate and apply technologies in the science class.

- **Learner-teacher interactions:** This involves the interaction between students and teachers in the teaching /learning process which includes interaction during lessons and outside classroom interactions.
- **Learner-Learner interaction:** This is the interaction in various group studies either in the classroom or outside the classroom. The implication is that there should be group studies which are very important to students' learning in science.
- **Learner-environment interaction:** This involves various activities carried out by students using community as learning resources. Using learners' community as resources is very important to science learning in general. Teachers can effectively deliver their science lessons by using active learning strategies such as ICT tools in the teaching and learning of science. Such teaching strategies will get the students- involved in learning activities. According to Shedd (2004), science teachers must incorporate technology into their science classes since teaching has gone beyond traditional method of talk and chalk. This implies that the integration of Information and Communication Technology (ICT) in science classes is very imperative (Aina, 2012). Such methods will create excitement in students and thus induce their critical thinking and conceptual understanding of the subject.

The concept of ICT

Information and Communications Technology (ICT) according to Kola (2013) is an umbrella term that includes any communication device or application. It comprises of radio, television, cellular phones, computers, and network hardware and software and satellite systems. Information and Communication Technology also consist of the various services and applications associated with them. These services and applications includes video conferencing and distance learning. ICTs are defined as basically information — handling tools — a varied set of goal, applications and services that are used to produce, store, process, distributed and exchange information (United Nations Development Programme (UNDP), 2004). The different ICT tools are able to work together and combine to form 'networked world' — a massive infrastructure of interconnected telephone services, standardized computing handling the internet, radio and telephone which now reaches into every corner of the globe. ICT also refers to audio visual aids such as the transparency and slides, tape and cassettes records and radio; video cassette and television, and film.

ICTS are crucially important to sustainable development in developing countries. Thioune (2003) opines that for the past two decades most developing countries have unstressed significant changes that can be traced to ICTs. ICTs are credited with the ability to transform, and deep and significant changes are expected from their use. Stressing on the importance of ICT, the Federal Republic of Nigeria (FRN) (2001), explained that surviving in the information age depends on access to development of any nation in a rapidly changing global environment, and it challenges us to devise

initiative to address a host of issues such as reliable infrastructure, stalled human resources, open government and other essential issues of capacity building. Information and Communication Technology (ICT) can contribute to universal access to education, equity in education, the delivery of quality learning and teaching, teachers' professional development and more efficient education management, governance and administration. The implication is that there is a need for ICT in education.

ICT in education is the teaching and learning with ICT. ICT in education has a multiplier effect throughout the education system by:

1. Enhancing learning and providing students with new sets of skills
2. Reaching students with poor or no access
3. Facilitating and improving the training of teachers
4. Minimizing costs associated with the delivery of traditional instruction and
5. Improving the administration of schools in order to enhance the quality and efficiency of service delivery.

The implication of the above is that ICT has the potential to make learning more experimental. The large amount of data and visual availability on any topic can be brought to the classroom from all over the world thereby making educational process more meaningful. Educationists have seen the use of computers and the internet as ideal for enhancing the quality of education by making learning more relevant to life.

ICT in Education can be seen from two angles

1. The use of ICT for enhancing learning
2. Exposure to the use of ICT in general which will basically include the use of computers.

Considering ICT in Education from both angles will greatly facilitate the acquisition and absorption of knowledge and offering students unprecedented opportunities to enhance their learning. Mikre (2011) explained that ICT in Education have revolutionized the way students learn today and are now transforming education systems. According to Bransford, Brown and Cocking as cited in Volman (2005), there is a common belief that the use of ICT in education contributes to a more constructivist learning and an increase in activity and greater responsibility of students. In addition, Volman opines that the gradual progress in using computers changes from learning about computers to learning computers and finally to learning with computers. This according to Mikre (2011) limits the role of the teacher to supporting, advising and coaching students rather than merely transmitting knowledge.

ICT in education is a great help in the constructivist approach of learning-an approach that considers learning as authentic and learner-centered where one can design simulated individualized learning environments to students. To achieve the

millennium Development Goals (MDGs), ICT education must be embraced through our academic learning and specifically through science learning. There are many teaching resources that can be used to teach science effectively. The philosophy of the Nigerian Certificate in Education (NCE) of science education is inspired by the desire to help students become intellectually informed in science and the need to produce competent and effective teachers with good mastery of content, method and knowledge of the development of the learners (Kola, 2013).

ICT integration into science learning can be seen as the best solution for improving students' academic performance since ICT attracts students and makes them lively in class, promotes students interaction in the course of learning thereby increasing, the effectiveness of teaching and improving students' learning. It is therefore desirable that science teachers are trained to make use of ICTs in their teaching.

Application of ICT in Science Class

ICT can be applied in the science class under four main categories;

1. Finding more about science and current discoveries through the use of internet, email CD-Rom, Database, and video coverage.
2. Collecting, handling and interpreting/analyzing data involved in science through data logging using software such as Excel for spreadsheets and graphs
3. Aiding understanding/explanation of science concepts, especially visualizing abstract concepts and processing by using models, simulation games, digital video and multimedia adventures and,
4. Communicating ideas through the use of presentation software such as PowerPoint digital Video, desktop publishing, web based publishing (Oldham, 2003).

Applying ICT in science concept refers to the set of activities which involves planning, organizing, control, staffing, directing and coordinating ICT towards the goal of developing people as a resource material. Ebong (2004) opined that the science teacher should be involved in the curriculum reformation since planning the curriculum courses should aim at optimizing the contribution of individuals and groups, integrating related information and communication component and coordinating delegated tasks in the management process.

ICT materials can be applied in the teaching of science in the following ways.

1. Instrumentation-Appropriate software can be used to describe working principles of sophisticated instruments. For instance the teaching of electric motor in science can be done with the aid of Encarta educational software.
2. Analysis of Data- Data generated from experiment can be analyzed using appropriate software.
3. Computer can be used to stimulate various phenomena in science to give a better representation of the real life occurrence:

4. Laboratories experiments can also be simulated and put into memory devices for students to learn at their own pace.
5. Lecture and process of learning instruction can be presented with the use of PowerPoint.

Apart from educational software, video and community resource can be used for learning in science. According to Kola (2013), soldering of resistors, transistors and other active electronics components can be done showing videos of electronic technicians at work already to surmount the problem of not carrying out electronic experiments in science due to the problem of electric power supply in the country. In this way, students will be able to learn how to perform such activity even though they were not directly taught in the class by their science teacher. Wilson and Redish (1989) also opined that microcomputer can be used to acquire data from thermistor, photodiodes and pressure transistors and be used to teach topic like chain reaction and retroactive decay in nuclear physics which cannot be easily carried out in classroom situation. Computer simulation and video can also be used to teach concepts like optical phenomena, magnetic and mechanic phenomena, movement of air, its interactions and collision which seemed to be abstract to students who find them very difficult to comprehend. According to Kola (2013) Computer Assisted Instruction (CAI) tools like spreadsheet and word processor are used to collect and analyze data.

Aina & Adedo (2013) argued that feedback is very important in teaching and learning process because it improves students' learning. Supporting this, Kola (2013) stated that such feedback could be gotten through computer. Explaining further Kola said that students can learn how to spell words correctly in a word processor when text is being underlined by the computer. According to Nguyen & Nguyen (2012), learning activities could be communicated through e-mail system. Students could be in contact with their teacher who is away from school by sending learning activities to their teacher through e-mail. Many teachers supervise their students' project through this method.

Students can also learn a lot through internet, social network and online chat. Physical articles in journals are uploaded into website or blog to be accessed for learning (Kola, 2013). Osunade (2003) explained that internet is a valuable source of information for students looking-for ideas for writing their projects and assignments.

Benefits of ICT to Science Education

Application of ICT to science education has numerous benefits. According to Kola (2013), such benefits include: -

- Helping science students to learn science concepts, laws and theories with ease and also retaining what they have learnt in their memory for a very long period.
- Promoting hard work for both science teachers and students.

- Improving science students' participation in classroom activities.
>Helping both science student and teachers to exchange ideas, learning materials and teaching strategies quickly.
- Affording both science teachers and students the opportunity of organizing seminars, workshops and conferences on uses relating to science education across the globe without boundary restriction.
- Helping both science teachers and students sustain and update their knowledge in science.
- Helping science students to understand abstract and very difficult concepts in science.

Yusuf and Yusuf (2009) explained that the application of ICT in science education has the potential for enhancing the tools and environment for science learning since it allows materials to be presented in multiple media, motivate and engage science students in learning process, foster enquiry and exploration and provide access to world made information resources. Explaining the importance of ICT in science education, Okpurukhre, William, Esikpe and Ezewi (2013) opined that through the internet, science students and teachers can gain access to a rich source of information to keep abreast of new sources of knowledge. They went further to explain that through the internet, digital libraries science teachers can easily get access to relevant and current resources in science. This will therefore enhance the quality of science-students' learning through ICT; science teachers, students, Librarians and schools can communicate with one another and share information that will enhance understanding of science concepts. Stressing on the benefits of ICT in science education, Wiki Education (2009) asserted that ICT is beneficial to science education in the following ways: Giving science students

- Access to a variety of learning resources ICT provides a lot of learning resources that will enhance learning in all aspects of science
- Immediacy of information - ICT has a fast pace of imparting knowledge to students thereby enabling science students to be educated anywhere and at anytime because of the already available information on the internet.
- Anytime anywhere learning - ICT make it possible for science students to study at will. According to Yung (2002), such flexibility in learning has heightened the availability of first — in — time learning and has also provided opportunity for more learners who perilously were constrained by other commitment.
- Authentic and up to date information.
- Access to online Libraries — through internet service where a lot of date are available.
- Individualization of Instruction — ICT encourage students to learn at their own pace.
- The teaching science is made interesting though ICT tools like video thereby ensuing high reiterations of learning experiences.

Challenges to the Use of ICTs in Secondary Schools.

Many problems have been militating against the application of ICT in Nigerian secondary schools. Some of these factors impeding the use of ICT in education have been identified by STAN (2011) and Nzewi (2009) to include:

- Lacks of training among teachers — many teachers in the secondary schools are computer illiterates and according to Nzewi (2009) in some states where attempt were made to train them, adequate time and resources were not devoted to the exercise.
- Inadequate funding to support the purchase of ICT tools like computer.
- High enrolment in school — According to Fafunwa as cited in Okeke and Nzewi (2009), the universal primary education led to remarkable increase in school enrolment from 6 million in 1976 to 15 million in 1982. There is therefore an increase in school population without a corresponding increase in the supply of ICT facilities and this has posed a serious problem on the educational system.
- Lack of motivation and need among teachers to adopt ICT as teaching tools some teachers are not aware of the innovations ICT has brought to teaching and learning. Processes and have refused to adopt it as a teaching tool.
- Lack of skills — Nzewi (2009) observed acute shortage of trained personnel in application software, operating system etc which has resulted in the lack of human skills and knowledge needed to integrate ICT into the education sector.
- Conservation attitude of teachers — Teachers have found it difficult to embrace the innovations offered by ICT facilities due to the fact that, according to Schein(1988), individuals and organization possess natural tendency to maintain a steady state and any change that disrupts this status quo are viewed with caution.
- Irregular and inadequate power supply — there is lack of uninterrupted power supply in Nigeria and this imposes threat to the education system since these ICT facilities require electric power supply for effective functioning.
- High cost of technology — computer equipment and others like software, printers, scanners etc are very expensive and not easily affordable by schools or individuals.

Solutions

In order to solve some of these problems, the following action should be taken.

1. Government should supply sufficient ICT teaching equipment like computers, projectors and educational software in schools and ensure that all schools are internet compliance. Such equipment should be supervised regularly to make sure that they are there and are used for the purpose for which they were supplied.
2. Government should also organize computer conferences, seminars and workshop for science teachers and make sure that all science teachers in both private and public secondary schools are mandated to attend these trainings that will improve their competencies in the use of ICTs.

3. Government should fund the schools very well for them to be able to purchase ICT tools and other technologies to be used in the schools.
- 4: Power generation must be given adequate attention by the government in order to maintain a country with uninterrupted power supply which is the heart of every technology.
5. Science teachers should be encouraged to have laptops and modems which will enable them have access to internet anywhere and at anytime.
6. Science students and teachers should be encouraged to have e-mail addresses. Science teachers should also give their student assignments on internet for them to be able to tap the rich resources from the internet.

Conclusion and Recommendation

The application of ICT in science education can improve students' academic performance in science. There is a great need for all the science teachers to be computer literate so that they can deliver properly to the students. However there are a lot of problems militating against the use of ICTs in the science classroom. These problems include among others, high enrolment in schools, lack of motivation among teachers and irregular and inadequate supply of electricity. To surmount these problems, the government, individuals, teachers and students have to make necessary sacrifices.

REFERENCES

- Aina, J.K. (2012). Factors affecting students, performance in science in Nigeria schools. Retrieved from <http://www.basearticle.com/articledetailcfn?Articlecd=4246692>
- Aina, J.K. & Adedo, G.A (2013). Correlation between continuous assessment (CA) and students' performance in science *Journal of education and Practice* 4(6,), 6- 9.
- Aiyelabegan, T.A (2003). Effect of physics practical on students academic performance in senior secondary school certificate examination in Kwara State *Lafiagi Journal of Science Education* 1 & 2, 34.
- Becta, M. (2004). What factors support or prevent teachers from using ICT in their classrooms? *Paper presented at the British Education Research Association Annual Conference.*
- Federal Republic of Nigeria (2001). Nigeria National Policy for. Information Technology (11) Available: www.mtda.gov.ng/nigeriapolicy.pdf. Madu 2000 and Fapothunda 1999.
- Kola, J.K. (2013). Effective Teaching and Learning in science Education through Information and Communication Technology (ICT). *IOSR Journal of Research & method in Education (WSRJRME) e-ISSN 2320 —7388, P- ISSN 2320 — 737 x Vol 2 issue 5 pp 43-47.*

- Ngyuyen, N. Williams J & Nguyem, T (2012). The use of ICT in teaching tertiary physics; Technology and Pedagogy. *Asian Pacific Forum on Science Learning and Teaching* 13 (2). Article 6.1.
- Nzewi, U.M. (2009). Information and Communication Technology in Teaching/Learning. Curriculum; Theory and Practice. *Curriculum organization of Nigeria pp 160-166*.
- Ogu, N, M. & Ononugbo, P.C. (2006). Developing Human Resources in Physics Education: The Bedrock for effective Teaching of Physics. *Proceedings of the 47th Annual Conference of the science Teachers Association of Nigeria (STAN)*, 291-293.
- Okpunhkre, W & Ese, 'W.E. (2013) Enhancing the teaching of science using information and Communication Technology (ICT) for optimal quality Education in Senior Secondary Schools in Delta State. *The Global Journal of Educational Perspective* 1(1); 68-76.
- Oldham, V. (2003). Effective use of ICT in secondary science guideline and case studies. *Schools Science Review* 84 (309); 53 — 60.
- Shedd J. (2004). Incorporating Technology in the classroom. *A publication of the school of Education. Syracuse University USA. Education Exchange*.
- Thiouné., R.M.C. (2003). Information and Communication Technologies for development in Africa; development volume I. Ottawa: IDRC. Available: <http://www.idrc.ca>
- UNDP (2004): Promoting ICT for Human Development. A proceeding Regional Human Development Report in Asia 2004: Realizing the millennium Development Goals. <http://www.apdip.net/projects/rhdr/resources/PDF> on December 2009.
- Volman M, (2005). Variety of role for a new type of teacher Educational technology and the teacher profession. *Teacher and Teacher Education*, 21, 15-31.
- Wanbugu, P.W & Changeiywo, J.M. (2008) Effect of mastery learning approach on secondary school students physics achievement. *Eurasia Journal of Mathematics, Science & Technology Education*, 4(3,); 293-302.
- Yusuf, M.O. & Yusuf, H.T. (2009). Education Reforms in Nigeria: The potentials of Information and Communication Technology (ICT).