IMPROVED UTILIZATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs) FOR TEACHERS' EFFECTIVE SCIENCE TEACHING FOR SUSTAINABLE DEVELOPMENT

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Abstract

The use of information and communication technology in learning can be qualitatively different and the process of learning in the classroom can become significantly richer as students have access to new and different types of information. Entering the information age refers to more than computer literacy, but dealing with the support given to teachers with reconstructive attitude, sensitivity, and the teacher-student relationship. The instructional delivery system should be focused on achieving understanding of information and skills that are being passed within the classroom environment. ICT allows the learners to make an interactive use of the computer for its purposes and improve successful use of computer-based instruction, but this required careful planning, choices of hardware and in the matching of educational programmes to curricular objectives, teachers' capability and students' abilities both in science class and learning process generally. This paper therefore, discussed the teacher-curriculum interface, usefulness of computer in the classroom, computer-student interaction, teacher-students relationship, its effectiveness in teaching science and integration of computer education for science teachers. Conclusion and far reaching recommendations were made.

Keywords: ICTs, Computer-Student Interaction, Teacher-Curriculum Interface, Teaching Science, Teacher - Student Interaction

Introduction

Information and Communication Technologies is an omnibus term that combines computer and telecommunications technology. Information and communication technology is concerned with the technology used in handling, acquiring, processing, storing and disseminating information by means of computer, office machines and telecommunication (Ehikhamenor, 2002; Oketunji, 2000). The world is moving rapidly into the maturity stage of an information age that is being driven by an acceleration of advances in information and communication technologies. Computer on the other hand is an electronic device that can receive a set of instruction, programmes, and then carry out the programmes by performing calculation on numerical data or by manipulating other forms of information (Olori, 2007).

Through the use of advanced computing and telecommunication technology, the process of learning in the classroom can become significantly richer as students have access to new and different types of information, which can in turn be manipulated with computer through graphic displays or controlled experiments in ways never before possible Huang (2000). With the use of information technology, students can communicate their results and conclusions in a variety of media to their teachers, students in the next classroom, or students around the world (Olori, 2008).

Adu and Arowolo (2010) explained that instead of reading about the human circulatory system and seeing textbook pictures depicting blood flow, students can use simulation mode of computer technology to see blood moving through veins and arteries, watch the process of oxygen entering the bloodstream, and experiment to understand the effects of increased pulse or cholesterol-filled arteries on blood flow.

Olori (2007) explained that the components of ICT tools that are available for teaching and learning include: computer, virtual learning, internet, synchronous and asynchronous learning, mobile learning for distance education, blogger, computer-based instruction, what's up, flicker, google plus etc. Adesanya and Adeniji (2007) opined that Information technologies have opened up a new era in manufacturing through the techniques of automation and they have enhanced the modern communication systems. Information technologies are regarded as essential tools in almost every field of human endeavour, including education (Olori, 2009). The use of technology has been accepted in schools because it promises a new dimension to education. Abimbade (2005) and Diji (2005) proposed that ICT enhances education by providing the following:

(i) more active learning;
(ii) varied sensory and conceptual models;
(iii) less mental drudgery;
(iv) learning nearer the speed of thought;
(v) leaning better tailored to individuals;
(vi) more independent Leaning; and
(vii) better aid to abstraction.

However, the challenge is to incorporate the microcomputer successfully into the school curriculum and maximize its benefits to science education. As is often the case, efforts into taken advantage of integrating ICTs into the classroom make important demands on individual teachers (Olori, 2008). This demands that computing should be accommodated in the curriculum for students and as well as teachers. Abimbade (1996), Huang (2000), Egunjobi and Ibode (2005), analyzed the magnitude of the teacher training efforts that are necessary to attain the goals of computer education for teachers, four opportunities were recommended:

1. Pre-service training of education students
2. In-service training of practicing teachers
3. Research on computer use in science education
4. Graduate programmes on computers in science education.

The innovation of computers comes at a time when teacher education and the tasks for teacher educators are being called into question. Jegede, Okebukola and Ajewole (1990), added that the use of computers to facilitate learning within the formal teaching - learning situation will eventually enhance acceptance of this versatile technology in the developing countries which are normally dominated by indigenous technologies. Examples of traditional technologies are words in print explanation of books, charts, as well as word of mouth explanation by the teacher. Oketunji, (2000) observed that information and communication technologies popularly known as ICTs is the latest innovation in the practice of education. The concept of ICTs aided educational practice involves the use of the computer and computer related facilities as teaching aids in the education of students. The reliance on the ICTs and its opportunities are steadily on the increase with the development and growth in the information communication technology sector. In Nigeria, the joint admission and matriculation board has commenced the use of computer-based examination(CBE) for the unified tertiary matriculation examination and it was a successful attempt on the part of the body, because the feedback was timely available.

The Teacher-Curriculum Interface

The curriculum is usually structured via consideration of the choice of learning tasks, materials and equipment, learning arrangements and settings, and instructional methods. Monke (1998), Adesanya & Ero (2005) opined that the traditional pre-service training for teachers has emphasized content and method. Computer is accompanied by other possibilities for the curriculum, ranging from teaching with computers and teaching through computers. According to Abimbade (2006), these possibilities come from the three broad categories of computer used in education and they include: content related to teaching about computers involves courses in computers literacy, the impact of computers in education and society, and the convergence of computer use with the appropriate grade level and the subject matter.

Teaching with computers refers to using Computer-Aided Instruction (CAI) and at a more intensive level the modifying, adopting or writing of relevant instructional software materials, knowledge of the psychological theories and instructional methods according to which software is designed. Egunjobi, Olori, Adesanya and Akorede, (2007) added that computer is used for instructional aspect, making use of software which assists in the learning of the content and concepts of major subjects. However, other software as spreadsheets, database, data analysis programmes also allow the learners to make an interactive use of the computer for its purposes. Omoniyi,Olori and Adesanya (2010) opined that successful computer-based instruction requires careful planning, informed choices of hardware and in the matching of educational programmes to curricular objectives and students' abilities.

The Computer-Curriculum Interface

This area covers content and method in the computing curriculum. Abimbade (2005), identified the modes through which computer can be used for an effective learning. They are to break problems down into small steps, give immediate feedback, and provide correction impersonally, and repeats endlessly. Aremu (2005), Abimbade (2005) and Adesanya (2006) further added that the functions of computer which are now available to

schools for effective teaching and learning include the following: computer literacy, drill and practice, programming to solve problems, recreational games, demonstration labs, administration, maintaining teacher records, designing computer-base test, completion and correction of student's worksheets and word processing.

However, according to Adesanya and Ero (2005), teachers still need to analyze computer offerings carefully to determine their educational value. The effectiveness of traditional teaching methods must be compared with the benefits to be derived from computer uses in the classroom. Abimbade(2005),observed that computer will provide the possibilities of linear, branched and generative assisted learning programmes, algorithmic thinking flow chart, mathematics learning models for concepts which can be presented mathematically. Schnakenberg and Sullivan (2000) observed that computer will provide the advantage of time-shared interaction, computer controlled information television, simulation mode which models some process or system, games with audio and visual effects, emancipator mode, using the computer as labour-saving device, artificial intelligence for remembering and accessing relevant knowledge, and dialogue systems which restrict student's answers.

Computer- Classroom Concerns

Would the computer be used as a tool, a resource, a social organizer or learning, or a promoter of student's achievement? Would it be used to assign students to work at appropriate grade levels? In attempting to resolve these questions, Abimbade (2005) submitted that the task of planning is not to match the computer and the classroom, but to train them to complement each other. It is expected that this approach may result in classroom re-organization. The computer appears as an individualized intellectual environment, whereas classrooms are group interactive systems. Aremu (2005) added that software has to be designed to attain the single focus formed in the traditional classroom. An important element of learning in a typical classroom environment is the social and communication interactions between a student and the teacher, and between a student and another student.

According to Schnakenberg and Sullivan (2000), new applications of information and communications technologies, such as e-mail, internet, the World Wide Web and video-conferences have created many new communication possibilities for school. In a classroom connected to the internet, communication over distance is simpler than ever before. Communication outside the closed culture of a school can extend cultural understanding beyond the immediate social environment. Pupils from different countries of the world can exchange experiences with pupils using e-mail or a videoconference. When learners work with ICTs, they often work collaboratively in group or team. The experience of group work brings new benefits, by stimulating pupils to develop the interpersonal skills necessary for life after school.

Information and Communication Technologies have something to offer both teachers and learners, whatever their individual capabilities / abilities (Jegede, Okebukola, and Ajewole, 1990; Olori, 2007). For instance, e-mail, for example, offers "virtual mobility" to those who lack physical mobility. Olori (2010) posited that information technologies offer the anytime,

anywhere and anyplace possibilities in a learning environment. Students in a virtual learning environment can visit museum and other field trip activities without necessarily leaving the computer laboratory or school environment. Also, communications technologies can also be a force for exclusion. Learners are disappointed or frustrated when they encounter language barriers on the www, for example. Sometimes enthusiastic learners exclude those who are more tentative about using computers, while some are reluctant to use computers at all. Adesanya and Ero, (2005), asserted that ICTS can help to make the classroom a more inclusive environment whatever individual capabilities. For ICTs to be integrated into the school system, Abimbade (2005) cited parts of the Scotland and United Kingdom National initiatives, which is as follows:

(i) To increase the amount of, and access to up-to-date ICT equipment to schools (i.e. developing the infrastructure through fund for ICT and building in schools and learning centers);and

(ii) To improve resources available, particularly online, to support classroom work (i.e. resources and school-based support); and to enhance staff skills and use of ICT to deliver the curriculum (i.e. Staff development)

Computer-Student Interaction

Specifically, the intrinsic motivation and interest presently provided by the computer in the classroom may pale with time (Adesanya & Adeniji, 2007). At the beginning, computer may appeal to the students and help in the custodial functions of schooling, but long intense hours at a terminal may be considered a waste of time. It is envisaged that the computer will alter the shape of the students' interaction and may foster elitism, promote distancing, and generate students who are able to instruct their teachers. An insightful teacher education programmes should be able to structure diagnosis and remedies to allay these fears and recommend ways to further channel students interest and abilities towards desirable outcomes. Olori (2009) argued that though computer has great potentials for self-based learning, yet the social advantage of face-to- face interaction of students and teachers can never be undermined in a blended learning instruction. Teachers have been blending methods in the classroom for years, choosing the type of learning activities that best meet their learning objectives. Blended learning focuses on optimizing achievement of learning objectives by applying the ‘right’ learning technologies to match the ‘right’ personal learning style to transfer the ‘right’ skill to the ‘right’ person at the ‘right’ time (Singh & Reed, 2001). It is the combination of web-based learning resources and classroom- based learning in order to maximize the benefits of both face-to-face and online methods (Osguthorpe & Graham, 2003).

Teacher-Student Relationships

Changes would occur in the traditional teacher-student relationship, because the role of teacher is as a guide, monitor, resources person, strategist, organizer of learning, and diagnostician (Egunjobi & Ibode, 2005). In addition, the teacher could become an adapter of programmes to suit the needs of the learners. Thus, teacher education programme should be able to identify the changes in the teacher-pupils relationship and help teachers to cope with the new roles which would be required. In-service teachers who are already experiencing some of the changes would be able to assist in ICT training, thereby rendering

peer tutoring among teachers a potent recommendation(Haydn & Barton, 2007).Studies have shown that possession of 21st century skills in the use of technology by teachers and students can enhance teaching and learning outcomes(Dawson, 2008).

Effectiveness of ICTs in Teaching Science and Integration of Computer Education for Science Teachers

It has been emphasized by UNESCO Congress Report (1981) as cited in Godek (2004) that science education is an essential factor in improving the materials and cultural conditions of people's lives and a priority for cultural development. Science education improves the education of future scientists especially with the use of ICTs. It also fosters a greater and more relevant understanding of nature and findings of science among the populations as a whole. Moreover, science education gives children an awareness of technology and develops their personal experiences. Practical skills that are encouraged in technological activities helps children acquire resources of knowledge, intellectual and physical skills (Ogunkola, 2008).

Abimbade (2005) and Adesanya (2006) added that creative application programmes could address laboratory reports, lesson plan formats, teacher record and forecast, and routine tasks performed by teachers. Competency-based approach and the used of information gleaned from experts in the field can be used to identify the minimum ICT competence that professional teachers should possess. The individuals are then tested to ascertain their level of competency. The gap in knowledge provides the basis for selecting teaching skill that is required to be able to access the information on the computer from an individual package.

The teaching of science and technology through ICTs allows for integration in a manner by which educational software has the opportunity, not enjoyed by text books to cut across curricular lines (Adu and Arowolo, 2010). The teacher still continues to play an important role in the facilitation of science and technology investigation through ICTs. Teachers have the opportunity to demonstrate the software, allow students to practice using software and then assign learning tasks to the students according to individual ability and specific expectation of the curriculum.

Conclusion

The purpose of teaching at any level is to produce certain desirable changes in the learner because teaching develops skills, competencies and intellectual capacities in individuals. Therefore, the instructional delivery system should be focused on achieving understanding of information and skills that are being passed within the classroom environment. ICTs give rooms for individual learning that makes learning to be learner-controlled unlike traditional teacher-controlled method of teaching.

In year 2001, the Federal Government of Nigeria approved the Nigerian National Policy for Information Technology with the mission to use ICTs for teaching science and education in general. While some of the general objectives is to integrate ICTs into the main stream of education and training, the strategies of the policy is to restructuring the education system at all levels to respond effectively to the challenges. To address these, there is the need to

allocate special ICT development fund for education at all levels by the government. For instance, the Joint Admission and Matriculation Board, through its UTME has commenced the Computer-Based Test and it is expected that government, private sectors, and individuals will assist in one way or the other to supply computer gargets, software, and appointment of software developers into various schools right from the primary to tertiary level of education. It was further noted that right from college of education to university level, ICT s should be a course for all pre-service teachers so that these teachers can impact or transfer the knowledge acquired during training to the students in the classroom. In general, planning preparation, testing and evaluation procedures must be an ongoing task to determine the effectiveness of ICTs and the achievement of the goals of the computer education curriculum.

Recommendations

The following recommendations were made:

(i) That technology must be incorporated into science classroom teachings in Nigerian schools.

(ii) The computer-based- test (CBT) which the JAMB introduced should be encouraged and be applied to other examinations in Nigeria

(iii) That the teachers of Science Education in Nigerian public secondary schools should develop interest in the use of technology in order to enhance their teaching.

(iv) That workshops and seminars be organized regularly for ICT experts and science teachers on the improvisation of science materials/ gadgets.

(v) That specialist in the field of science and technology are to man science classrooms in Nigerian schools so that expertise experience will be applied in the laboratory management.

(vi) That curriculum planners, experts in educational technology and science education teachers should design a separate science course book that will incorporate the use of tape-recorders, headsets and computers for practical.

(vii) That parents should try as much as possible to encourage their children to make use of the computers and other ICT devices for their studies

(viii) The National commission for communication (NCC) in collaboration with Education Trust Fund (ETF), Tertiary Education Trust Fund (TETFUND) and other Non-Governmental Organizations (NGO) should assist to supply computer gargets, software, and appointment of software developers into various institutions, right from the primary to tertiary level of education.

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