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Improving Scientific Literacy among Secondary School Students through Integration of Information and Communication Technology

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ABSTRACT

This paper looks at improving scientific literacy among secondary school students through the integration of information and communications technology (ICT). The paper explained the term scientific literacy and the characteristics of students who are deemed to be scientifically literate. The state of scientific literacy among secondary school students was reviewed from earlier works. The meaning of ICT and its use in science classrooms and ways ICT could improve scientific literacy among secondary school students were examined. Finally, it was recommended that government should provide necessary infrastructure for the integration of ICT in our secondary school systems as provided for in the national policy on education. Also, that the training and re-training of ICT teachers and instructors should be encouraged in our secondary schools and that subject teachers in biology, chemistry and physics should be trained on the use of ICT so as to be familiar with teaching packages in their subject areas for use in secondary schools.

Keywords: *ICT, Scientific Literacy, Secondary School Students*

1. INTRODUCTION

Technology and science are tightly interwoven and breakthroughs are occurring in both at astounding rates. In the past decades, scientists have discovered how to clone animals and sent probes past the outer edges of the solar system. Many social and political issues that have come to the fore in the past decade have strong scientific underpinnings. Issues related to reproductive technologies, the environment and energy for example, require a scientifically literate population for wise decision making.

Scientific literacy is one of the several types of literacy such as written literacy, numerical literacy and digital literacy. In becoming scientifically literate, the student overcomes any fear of science. He or she is able to understand experiment and reasoning. Unlike language and number illiteracies that have always been established priorities in the primary years of schooling, science had no such history of establishment in these years. There were no obvious counterparts in science to the basics of reading, writing and number operations (fensham, 2008).

The federal republic of Nigeria in recognition of the place of ICT in advancing knowledge and skill in the modern age included the introduction of information and communication technology (ICT) into the school system in the 4th edition of the national policy on education. Accordingly, in pursuance of the goals of secondary education, the policy stated that "government shall provide necessary infrastructure and training for the integration of ICT in the school system in recognition of the role of ICT in advancing knowledge and skill in the modern world" (FGN, 2004:24). Obviously, the use of ICT in our secondary schools will improve scientific literacy among students which is the focus of this paper.

2. WHAT IS SCIENTIFIC LITERACY?

Scientific literacy had been a more commonly used terminology than "science for all" which was a popular slogan of the 1980s. The term "scientific literacy" became popular in the 1990's as a new slogan for the intended purpose of school science. Despite its operational popularity, scientific literacy did not have an obvious definition (fensham, 2008). However, GBAMANJA (1999) defined scientific literacy as the "knowledge and understanding of events and happenings in the environment". According to the national education standards (1996), scientific literacy is knowledge and understanding of the scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity. Renner and Stafford (1972) as cited by GBAMANJA (1999) opined that scientific literacy deals with:

(a) Understanding (knowledge of) one's environment
(b) The process of inquiry by which understanding the environment is gained and
(c) The spirit of science.

In this view, these three are like intellectual development making up the base of the pyramid. In the view of Durant (1993), scientific literacy stands for what the general public ought to know about science. Jenkins (1994) opined that scientific literacy is an appreciation of the nature, aims and general limitations of science, coupled with some understanding of the more important scientific ideas.

Students who are scientifically literate according to national education standards (1996):

(a) Have the knowledge and understanding of scientific concepts and processes required for participation in a digital age society.
(b) Can ask, find, or determine answers to questions derived from curiosity about everyday experiences
(c) Have the ability to describe, explain and predict national phenomenon
(d) Are able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions
(e) Can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed.
(f) Are able to evaluate the quality of scientific information on the basis of the source and the methods used to generate it
(g) Have the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately.

From the foregoing, scientific literacy entails the manifestation of skills and knowledge in various facets of human Endeavour – the classroom, environment, economic, political and social concerns. However, the focus of this paper is on improving scientific literacy among secondary school students.

3. SCIENTIFIC LITERACY AMONG SECONDARY SCHOOL STUDENTS

Scientific literacy is important throughout a student's life as he or she participates in public policy issues related to technology, stays current with advances in areas like biotechnology, medicine and space exploration, and especially as he or she enters an increasingly scientifically –based workforce (national science education standards, 1996).

At present, the level of scientific literacy among secondary school science students can be said to be low. This assertion is based on the reported poor performance in science subjects in external examinations (IVOWI, OKEBUKOLA and OLUDATUN, 1992; ADEYEGBE, 1993; ADENIHI, 1998; Osborn, Simon and Collins, 2003).

Science and technology are tightly interwoven and literacy of both of them is important. Unfortunately, studies by bromide (1983) have shed some light on student's perceived difficulties in the contextual material of the science teachers' association of Nigeria (Stan) integrated science. The study revealed that the difficulty indices were higher in physics topics than chemistry and biology. The study further revealed that 31% of the total topics perceived difficult were attributed to the cognitive demands of the topics being too high for the students. Scientific literacy was soon being associated in a number of countries with an amount of content for learning in school science that was patently absurd. For example, the benchmarks of scientific literacy that were promoted by American association for the advancement of science (1993) in the united states of America, USA, exceeded what had hitherto been the science content to the academic groups of secondary students who had chosen to specialize in the sciences. According to fensham (2008), the curricula that set this very high level science learning as expected for all students must be a factor in the serious decline of interest in science. In the view of GBAMANJA (1999), traditionally, science teaching was dull, unimaginative and lacking in vigor. The teacher dispensed knowledge, while the learners learnt mostly by rote memorization. Students were passive learners. This scenario will certainly not encourage and motivate interest in science learning that is a major key to scientific literacy.

MORAVCISK (1976) envisaged that the best way to build science and technological knowledge in a nation is to strengthen science education. He says that science education imparts general knowledge and a broadminded attitude to the population, and produces creative specialists in various areas of human activity. He stated that successful development can hardly be visualized unless the spirit of inquiry and the attitude of experimentation permeate the population on a wide scale. A major goal of science education, therefore in the view of GBAMANJA (1999), should be to develop in the learner the spirit of inquiry and the right attitude to experimentation. If a larger portion of a society acquires these skills of inquiry and experimentation and uses them in solving the problems of the society, then scientific literacy is achieved.

4. WHAT IS INFORMATION AND COMMUNICATION TECHNOLOGY?

Information and communications technology (ICT) is an umbrella term that includes any communication device or application encompassing radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as video conferencing and distance learning. ICT consists of all technical means used to handle information and aid communication, including computer and network hardware, as well as necessary software. In order words, ICT consists of it as well as telephony, broadcast media, all types of audio and video processing and transmission and network based control and monitoring functions (folder, 2008). The expression – ICT was first used in 1997 in a report by denies Stevenson to the UK government (Stevenson, 1997). According to the world confederation for physical therapy (2011), information communication technology

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(ICT) is the phrase used to describe a range of technologies for gathering, storing, retrieving, processing, analyzing and transmitting information. BLURTON (2002) defined ICT as a diverse set of technological tools and resources used to communicate and to create, disseminate, store and manage information. These technologies include computers, the internet, broadcasting technologies (radio and television) and telephony (TINIO, 2002).

5. USE OF ICT IN SCIENCE CLASSROOMS

In recent years, there has been a groundswell of interest on how computers and the internet can best be harnessed to improve the efficiency and effectiveness of education at all levels and in both formal and non-formal settings. Older technologies such as the telephone, radio and television, although now given less attention has a longer and richer history as instructional tools (Cuban, 1986). For instance, radio and television have for over forty years been used for open and distance learning, although print remains the cheapest, most accessible and therefore most dominant delivery mechanism in both developed and developing countries (POTASHNIK and capper, 1998). TINIO (2002) observed that the use of computers and the internet is still in its infancy in developing countries, if these are used at all, due to limited infrastructure and the attendant high cost of access. The observation of TINIO for developing countries is true of Nigeria where the power supply is still very poor. Most people especially in the rural areas live in perpetual darkness. Most schools even in the urban areas do not have the infrastructure for the use of computers and internet for classroom instructions. However some parts of the world have used ICT to facilitate teaching and learning in schools. For instance, the koth male community radio internet used both radio broadcasts and computer and internet technologies to facilitate the sharing of information and provide educational opportunities in a rural community in Sri Lanka (TAGHLOFF, 2001).

E-learning, although most commonly associated with higher education and corporate training, encompasses learning at all levels, both formal and non-formal, that uses an information network – the internet, an intranet (LAN) or extranet (wan) – whether wholly or in part for course delivery, interaction and or facilitation. Others prefer the term “online learning”. Web-based learning is a subset of e-learning and refers to learning using an internet browser (TINIO, 2002).

6. IMPROVING SCIENTIFIC LITERACY AMONG SECONDARY SCHOOL STUDENTS THROUGH ICT

Internet help students get acquainted with professional scientist’s working methods, making ever increasing use of computer, computer software and the internet.

In the view of TINIO (2002), for developing countries, ICTs have the potential for increasing access to and improving the relevance and quality of education. ICTs greatly facilitate the acquisition and absorption of knowledge, offering developing countries unprecedented opportunities to enhance educational systems, improve policy formulation (World Bank, 1998). Some of the ways ICT improves scientific literacy include:

(a) ICTs are applicable anywhere, anytime. One defining feature of ICTs is their ability to transcend time and space. ICTs make possible asynchronous learning or learning characterized by a time lag between the delivery of instruction and its reception by learners. Online course materials, for example may be accessed 24 hours a day, 7 days a week.

(b) Access to remote learning resources. Teachers and learners no longer have need to rely solely on printed books and other materials in physical media housed in libraries (and available in limited quantities) for their educational needs. With the internet and the world wide web, a wealth of learning materials in almost every subject and in a variety of media can now be accessed from anywhere at any time of the day by unlimited number of people.

(c) Motivation to learn: ICTs such as videos, television and multimedia computer software that combine text, sound and colorful moving images can be used to provide challenging authentic content that will engage the student in the learning process. This obviously will improve the interest and thereby the scientific literacy of the learner.

(d) ICTs facilitate the acquisition of basic skills and concepts that are the foundation of higher order thinking skills and creativity through drill and practice. Most of the early uses of computer were computer-based learning (also called computer-assisted instruction) that focused on mastery skills and content through repetition and reinforcement.

(e) Active learning: ICT – enhanced learning mobilizes tools for examination, calculation and analysis of information. Learners therefore learn as they do and whenever appropriate, work on real-life problems in-depth, making learning less abstract and more relevant to the learners’ life situation.

(f) Collaborative learning: ICT – supported learning encourages interaction and cooperation among students, teachers and experts regardless of where they are. This provides learners the opportunity to work

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with people from different cultures, thereby helping to enhance learners learning and communicative as well as global awareness.

(g) Creative learning: ICTs – supported learning promotes the manipulation of existing information and the creation of real-world products rather than regurgitation of received information.

7. SUMMARY/RECOMMENDATION

Scientific literacy has being associated or advocated in a number of countries. Some of these countries have added an amount of content for learning school science. Curricula that set this very high level of science learning as expected for all students has been identified as a factor in the serious decline of interest in science among secondary school students. The use of ICT however helps students learn science by giving access to information and ways to measure and analyze variables.

RECOMMENDATIONS

(a) Government should provide necessary infrastructure for the integration of ICT in our secondary school systems as provided for in the national policy on education.

(b) The training and re-training of ICT teachers and instructors should be encouraged in our secondary schools.

(c) Subject teachers in biology, chemistry and physics should be trained on the use of ICT to be familiar with teaching packages in their subject area for use in secondary schools.

(d) Students should be given opportunity to apply and develop their ICT capability through the use of ICT tools to support the learning in science.

(e) Science students should be taught the knowledge, skills and understanding through using a range of sources of information and data including relevant software in the various science subjects.

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