ICT INTEGRATION IN SCIENCE EDUCATION IN THE 21ST CENURY: OBSTACLES AND ADVANTAGES

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Abstract
Advances in information and communication technologies (ICT) have also affected educational institutions. Due to its importance in society, science education should integrate ICT. The paper examines the obstacles and advantages of integrating ICT in science education in the 21st century. The author emphasizes that it will important to identify the possible obstacles in the integration of ICT in science education in order to take the required preventive measures. The advantages of ICT are enumerated and explained. Recommendations for ICT integration in science education instruction are proffered.

Introduction

For some years now, Information and Communication Technology is becoming a household name in Education industry in every part of the world. Some countries are yet to embrace, invest and introduce ICT in their educational system. However, a lot of hiccups hindering the takeoff of such laudable scientific venture in school by teachers in different parts of the world have been viewed and reviewed by so many researchers from all walks of life.

The advent of educational technology and its more widespread access in schools potentially has an important part to play in reshaping the curriculum and pedagogy of science. It offers easy access to a vast array of internet resources, other new tools and resources that facilitate and extend opportunities for empirical enquiry both inside and outside the classroom. Thus, in a very real sense, it offers opportunities to dissolve the boundaries that demarcate school science from contemporary science by facilitating access to a wide body of data such as real time, air pollution, measurement, epidemiological statistics, or providing direct links to high quality astronomical telescope and providing ready access to a wealth of information about science in the making.

However, the paper is aimed to act as a converging point and to dig outthe advantagesand obstacles of ICT integration in science education instruction.

Information and Communication Technology and Science Education

Technology is defined by Advance Learners' Dictionary of Current English as: the systematic application of knowledge to practical task in industry. Guha (1984) said that it is the creative application of science to industrial purpose. This implies that it is something that exists and can be seen, touched, and measured and so on. Here the product and process conception of both education and technology have permeated education thereby giving rise to what Lumsdaine (1967) identified as educational technology. Education is regarded as hardware or product approach of educational technology (that is the use of media and equipment in teaching learning process) and technology is regarded as the software or process approach (which is concerned essentially with the development of learning experience through the application of the sciences of learning). Information technology is the study or use of electronic process for storing information and making it available for use.

Information technology therefore can be traced from the Stone Age period of man's historical development (Guha 1984). This Stone Age period witnessed the use of concrete objects such as stones, pebbles, cowries, beads and sticks. These items formed versatile visuals and they were utilized to promote effectiveness and efficiency in communication and learning. This implies that in the ultimate goal of the education, Information Technology concept is to generate extensive exchange of textual and graphical information over computer links, a development

that has revolutionized the working practice of a very large percentage of working population of Nigerians. Generally, information and communication technology in Education is a worthwhile course, which will spur the basis of the study of science and technology together with its implementation to teaching and learning situation.

Advantages

There are so many advantages of ICT integration in Science Education in our school. They are as follows:

(a) Use of ICT to support science teaching and learning.

Currently, the curriculum is still driven by the agenda of the professional scientific community with well-established pedagogy which is primary base upon transmission of predefined, value free content knowledge. However, the demands for change embodied in new curricula such as 21st century School will require teachers to adapt and adopt a different set of pedagogic practical. Its goal of fostering scientific literacy involves developing a knowledge not only of the broad explanatory themes of science but also of some of the discourse and practical of scientists, including the process of theory construction, decision making communication, and school factors that influence scientists' work.

(b) Increasing currency and scope of reference and experience.

Use of ICT, especially the internet, can open up to a broader range of up to date tools and information resources, and increase the currency and authenticity of school work far beyond that which textbooks and other resources can offer. It allows pupils to relate their work more closely to the outside world to obtain live news or real data. For example, concerning an earthquake, pupils can even ask questions of real scientists or collaboration or pool result with peers elsewhere.

Using ICT further allows teachers and pupils to observe or interact with simulations, animations or phenomena, in novel ways that may be too dangerous, complex or expensive for the school laboratory. It provides access to new forms of data previously unavailable. Data logging can offer measurements of transient phenomena, remote and long term monitoring and increasing sensitivity. For example, it is commonly used to measure speed of a moving object by measuring the time taken to pass through a light gate and combing this with manual measurement of its stopping distance.

(c) Supporting exploration and experimentation

The use of graphing or modeling tools provides dynamic, visual representation of data collection electronically or otherwise. Uses of these tools offer immediate feedback to pupils and introduce a more experimental playful style in which trends are investigated, and ideas are tested and refined.

Through providing an immediate link between an activity and its results, the likelihood is increased that pupils will relate the graphical or diagrammatical representation of the relationship to activity itself. An immediately display of experimental results in a simple spreadsheet template can even guide the course of data collection through structuring their subsequent actions and predictions about the related variables, for instance, when investigating heat loss surface area and volume.

(d) Fostering self- regulated and collaborative learning

ICT is infinitely more than a surrogate tutor; its use for exploratory and experimental purpose offers teachers a powerful means of stimulating active learning and it offers learners more responsibility and control. Pupils carry out research or practical activity using ICT may work more (but not completely) independently of the teacher. To develop the concepts central to science teaching and to counter intuitive conceptions, pupils need to think for themselves. Their ideas need to be made explicit and challenge by new experiences. ICT tools have great potential to encourage this style of learning. Software can present many choices and alternatives to the pupils providing an interactive experience which is well suited to individual exploration. It is worth nothing that independence does not

mean pupils working alone. Peer collaboration between students working together on task, sharing their knowledge and expertise and producing joint outcomes is becoming a prevalent model for the use of educational technology.

However, a growing body of research evidence has accumulated for the cognitive benefits of technology-supported collaborative learning. Teachers too perceive that using ICT offers a stimulus and a medium for discussion between pupils. Note, however, those teachers themselves play a critical role in fostering, supporting and sensitively managing pupil collaboration as an effective vehicle for subject learning. For instance, graphing technology can act as a cognitive prop, provoking spontaneous investigations of relationships between variables or between numerical data or graphs, which can never be worthwhile manually.

(e) Forward looking strategies and prospects

For ICT integration in Science education in Nigeria, policy makers and government will work with civil society and the private sector to develop a multi-sectional approach to development that effectively harnesses the potential of ICT education to promote more effective process including the promotion of transparency and accountability.

Science education is essentially a scientific training which emerges from such a view that inevitably emphasizes the foundation or vocational aspects of the subject and offers a curriculum that consists of the fundamental concept of well- established, consensually agreed science. Science education is dominated by an emphasis on the content or facts of science rather than its processes consisting at its worst, frog march across the scientific landscape.

The following are of various obstacles to ICT integration in science education instruction.

Teacher Factor

Teacher's motivation to use ICT in the classroom is at present, adversely influenced by a number of constraints including;

- Lack of time to gain confidence and experience with technology;
- Limited access to reliable resource; a science curriculum overloaded with content; assessment that requires no use of the technology;
- Lack of subject specific guidance for using ICT to support learning;

Looking into teachers' confidence, it was discovered that a lot of teachers are novice in the use of ICT to teach their students. This in turn makes teaching boring in the class; hence lack of confidence. In some situations, the students sometimes are even more knowledgeable in usage of ICT than their teachers. This, according to the ideas of Bossley and Moon (2003), has many ways of hindering scientific and technology advancement in the classroom situation.

However, Becta (2003) identified as fear of admitting to their pupil by the teachers that they had limited knowledge in the area of ICT. This was supported by Russell and Bradley (1997) who referred to such as cyber phobia. Also Bradley and Russell (1997) in their independent study noticed that one of the causes of the computer anxiety is what they tagged "getting stuck and not knowing what to do next", and not understanding the computer jargon and the messages it gives. This was supported by Frabry and Higgs (1997).

Another aspect of the teachers' factor is their incompetence in the usage of ICT due to lack of adequate training. If training is inadequate or inappropriate then teachers will not be sufficiently prepared and perhaps confident enough to make full use of technology in and out of the classroom.However, knowing fully well that lack of time is a significant barrier; Ertmer (2001) suggested that provision of non- contact time for teachers to undertake ICT training during school hours will be a worthwhile decision. The issue of adequate training of teachers on how to manage learning should be given top priority as confirmed by Preston and Cox (2000).

Training of teachers should be done based on their experience and skills in using computers. Much encountered problem in this training is the field that educators in teachers' training institution don't even know how to use ICT and therefore constitute a menace to teaching and learning of science. Lerner and Temberlake (1998) suggested that encouragement and motivation for student to make use of ICT during teaching should be given a boost. The National Policy on Education FRN, (2004) stipulates that Teacher Education in science and technology be given a major emphasis and training in all education planning because no education can rise above the quality of its teachers. In spite of this policy, a lot of qualified ICT and mathematics teachers are still in the ratio of 1:20 schools. This is due to lack of access to resource and quality training by the appropriate authorities like the Federal Ministry of Education. This invariably makes the subject more theoretical than practical as discussed by Pelgrum (2001).

Even where the resources are available, Pelgrum (2000) in his pupils and computer ratio research still argued that the optimal usage of the computers is adversely affected by poor organization of resource. Preston (2002) believed that it is not having computer alone that matters but access and maintenance of the existing ones. Poorly specified and maintained machines means that they are unreliable and likely to cause disruption to even the best planned lesson. It is also discovered that lack of teacher's personal access to resources and time of its usage is another serious barrier militating against the uptake of ICT by teachers. While this technology can, in principle, be employed in diverse ways to support different curriculum goals and forms of pedagogy, such constraints have often stifled teacher's use of ICT in ways which effectively exploit its interactivity. Consequently, well integrated and effective classroom shows that even where technology is available; it is often under used and hindered by a set of practical constraints and teacher reservations. Whole classroom interactive teaching is also underdeveloped. At present, effective use of ICT in science seems to be confined to a minority of enthusiastic teachers or department.

In conclusion therefore, teachers are currently working towards harnessing the powerful potential of using ICT to support science learning as far as possible. Given the very real operational constraints further developments depends on providing them with more time, consistent access to reliable resource, encouragement and support and offering specific guidance for appropriate and effective use. Assessment frameworks (and their focus on end product) may also need to change in order to evaluate and thereby further encourage ICT supported learning.

Technical factors or support

Another obstacle for the integration of ICT in schools is the technical factor. This is split into two main areas. First, fear of the equipment breaking down during lessons due to teachers' lack of technical know how as noted by Cuban and Kirkpatrick, (2001). Secondly, lack of technical support in schools. This may cause more harm than good. This implies that if software goes down and there is no immediate technical support to repair or replace it, this will constitute a big menace towards learning at that time. Teachers lack of technical know – how keeps off the broken down equipment for several days pending the time a technical assistant will be available (Becta 2003).

Change of Attitude by Teachers

In the aspect of change of attitude towards usage of ICT by teachers, it is observed that in the teaching profession generally, there is an inherent resistance to change by both the teachers and the school. Albaugh, (1999) Dewes (2007) agrees that teachers' personal belief about teaching and learning with ICT affects their integration to new ideas and resistance to change in attitude. These invariably affect both the teachers and school. He suggested that the cellular organization of the school curriculum should be broad- based to accommodate diversification in the applicability of new ideas at any point in time. On the aspect of examination, a lot of teachers avoid the use of ICT either to set or mark public examination.

Age and Gender Difference

On the age difference researchers carried out by Becta, European Commission (2002) stated that as teachers' advances in age, it affects ICT usage. Hence, as the older teachers are no more anxious about implementation, the

knowledge of the younger teacher may phase out if not reactivated with current trends of development and findings from time to time. European Commission (2003) acclaims that male teacher's make use of ICT more than female, Bradley and Russell (1997) reports that the reverse is the case. But warn that if such should persist, then the barriers to the use of ICT will continue to show up especially in primary schools where female teachers are greater in number.

Summary of obstacles to integrating ICT in Science Education

The following are some obstacles of ICT in Science Education.

- Limitation of budget in the School.
- Limited technical support for ICT in the school.
- Having limited training of the school staff on ICT low number of computer in the school.
- Oldness or slowness of the system related to ICT in the system.
- Paucity of education software in the school.
- Low level of interest drive and being open to changes of city directorship of the Ministry of Education.
- Low level of training of the teachers and principals in the school.
- Low level of interest, drive and being open to change of the teachers and principals in the schools.

Recommendations

The following key points may be considered as recommendations for the ICT integration in science education institution development;

- ICT Education has great potential to assist Nigeria's goal to achieve education for all by the year 2015 and therefore should be maximally harnessed by every possible avenue;
- ICT education should be included in the educational curriculum including the provision of necessary infrastructural support and massive training and deployment of skilled manpower into both secondary and tertiary institutions;
- Young software developers should be trained and supported with the necessary equipment to develop nationally usable science education software.
- The various government education ministries and agencies should work together to develop an integrated broad-based model, and strategy for ICT education with a definitive timeline for its completion;
- Government should increase funding for the entire educational sector with particular emphasis on ICT;
- Government should also work with the private sector and civil society to ensure affordable and sustainable access to ICT infrastructure;
- A policy environment which encourages investment in ICT should be put in place including tariffs on import of ICT infrastructure, in order to promote affordability and wide range usage of all levels of the educational system;
- The importance of youth participation in ICT decision making process cannot be over emphasized; therefore, their participation in ICT policy making processes at the national and other levels should be encouraged and supported by all stakeholders.

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