ASSESSMENT OF THE EFFICACY OF COMPUTER ASSISTED INSTRUCTIONS IN ENHANCING STUDENTS' PERFORMANCE IN MATHEMATICS

AKPAN, E. Ebenezer, *Ph.D, FCICN, AP, PPGDCA, PHDCDPM*
Corporate Institute of Research and Computer Science,
140 Ikot Ekpene Road,
Uyo, Akwa Ibom State

AND

John George LUKE, *PhD*
Department of Mathematics
Faculty of Science
Golden Gate University
536 Mission Street
San Francisco, CA 94105
California
United States of America

ABSTRACT

This paper sought to investigate the efficacy of computer-assisted instruction in enhancing students' performance in mathematics. Computer Assisted Instructions (CAI) have become one of the most acceptable means of learning mathematics in recent times. It was observed in the study that information communication technology is a term used to refer to the use of computers and other related devices to organize, store, retrieve, and transmit information either within or outside an organization. It was also observed that ICT provides a rich global resource and a collaborative environment for the dissemination of knowledge and information. The study concluded that the various factors that hinder teacher training institutions in Nigeria from providing quality ICT knowledge and skills include lack of technically experienced lecturers, limited ICT facilities and infrastructure, inadequate course content for ICT training, lack of clear direction in the Nigerian National Policy for Information Technology (NNPIT) on teacher education, lack of leadership by professional organisations, and the problem of electricity. It was also observed that the application of information and communication technologies in Nigerian public secondary schools is poor but better in private schools, even though the Nigerian Federal Government has commissioned a mobile Internet unit (MIU) operated by the Nigerian National Information Technology Development Agency (NITDA). The result also proved that there is a true and undisputable picture of the significance of computer-assisted instruction in prevalent good performance of students in mathematics in our schools today. It was recommended in the paper that the government should provide the necessary infrastructure and training for the integration of ICTs in the secondary school system.

KEYWORDS: Mathematics, Computer assisted instruction, & Students performance

Introduction

The ability to use appropriate technology to meet students' mathematical needs and prepare them to assume future societal roles has become an issue of utmost concern and, at the same time, has attracted increased attention among researchers and practitioners in mathematics education. According to Eguavon (2002) and Iji & Udom (2007), the use of appropriate technology refers to using technological tools that can add depth, quality, and reinforcement to the learning process that is not readily obtainable by other means.

According to Okebukola (2006), technology is one of the driving forces that has revolutionalised the teaching of science and mathematics in schools. The viable benefits of ICT in the teaching and learning of science and mathematics cannot be underestimated in this digital age. For instance, the use of ICT helps to develop students' human capital through their exposure to the use of projectors, televisions, power points, among others. This equips them with skills that are rewarding in the labour market apart from the concretization of learning experiences and improved performance in science and mathematics (Barrow, 2009). The use of ICT has the capacity to improve students' learning and performance in science and mathematics. It is on this basis that this paper seeks to investigate the relationship between computer-assisted instruction and students' performance in mathematics.

Concepts of Information and Communication Technology (ICT)

Information technology can be defined as the hardware, software, telecommunications database management, and other information processing technologies used in computer-based information systems. IBM Annual Report (1997) It is the technology used for information processing. According to Zenas (2006), information communication technology is a term used to refer to the use of computers and other related devices to organize, store, retrieve, and transmit information either within or outside an organization. It can be viewed as the use of computers and other devices for data capture, processing, storage, retrieval, and transmission in its most organised form to aid the decision-making process in an organization. Adams (2009) defines IT as the acquisition, production, transformation, storage, and transfer of data by electronic means in forms such as local pictorial, textual, and numeric forms so as to facilitate interaction between people and machines. According to James Heskett (1999), ICT technology in a broad sense includes hardware, software, and methods. In other words, it is a combination of hardware (the physical machine), software (the electronic programme device that runs the hardware) and methods, the best

combination of hardware and software that affects information and presentation.

Fubara (1989) opines that computers are pieces of electronic equipment capable of carrying out very complex calculations and other activities in a very short space of time. A computer, therefore, is a sophisticated magnetic machine which is carefully assembled to be able to manipulate or solve any given complex problems that could take an ordinary human being a lot of time to accomplish in the shortest possible time. The computer, because of its capability, can manipulate a given problem, be it in the area of engineering, scientific, mathematical, all business problems, etc., without any human intervention (Ile, 2001). The computer can cut down the time used in solving problems and guarantee increased productivity. It can also reduce the cost of production and provide effective services. However, there are two types of computer components: hardware and software.

Ile (2001), further affirms that when information and communication technology (ICT) was first introduced, computers were very large and expensive. They required special rooms and were frequently difficult for the average person to operate and understand. The demand for information technology grows every day because of the belief that it saves time and manpower. The Wigatap Institute of Research (2004) states: "There is no doubt that we are in the "information age" where businesses are networked into the global village using electronic media to communicate with worldwide clients, such that the use of computer communication networks, the internet, or world wide web (www) sites, is flourishing with information that can be accessed with amazing speed across worldwide links.

Information and Communication Technology (ICT) refers to several kinds of technological applications and equipment that are utilised for processing, transmitting, or communicating data and information. This informs Olibie's (2008) assertion that one of the conditions that are very important in determining the extent to which a nation participates in the global world is information and communication technology (ICT). She maintains that it is an advancement in technology that provides a rich global resource and a collaborative environment for the dissemination of knowledge and information. Information and Communication Technology (ICT) is defined as computer-based tools used by people to work with the information and communication processing needs of an organization. As earlier stated, the network and several other devices (video, audio, photographic, cameras, etc.) that can convert information like text, images, and sound into common digital form (Yusuf, 2002).

Ifeanyi (2002), quoting Financial Digest (1994), described information technology as an information system meant to provide information so as to aid planning and organization; information technology (IT) includes the internet, e-mail and its variants, electronic commerce, etc. Isoun (2006) describes ICT as a term that is used to indicate a whole range of technologies involved in information processing and electronic communications, including the internet, electronic mail, and video conferencing. In the same way, Abolade and Yusuf (2005) opine that information and communication technologies relate principally to studying concepts, skills, processes, and applications of electronic devices.

Application of Information and Communication Technologies in Nigerian Secondary Schools

There are developments in the Nigerian education sector that indicate some level of ICT application in secondary schools. The Federal Government of Nigeria, in the National Policy on Education (Federal Republic of Nigeria, 2004), recognises the prominent role of ICTs in the modern world and has integrated ICTs into education in Nigeria. The document states that the government will provide basic infrastructure and training at the primary school level in order to achieve this goal. At the junior secondary school, computer education has been made a pre-vocational elective, and it is a vocational elective at the senior secondary school. It is also the intention of the government to provide the necessary infrastructure and training for the integration of ICTs into the secondary school system. It should be noted that 2004 was not the first attempt the Nigerian government made to introduce computer education in schools. In 1988, the Nigerian government enacted a policy on computer education. The plan was to establish pilot schools and diffuse computer education innovations first to all secondary schools, and then to primary schools. Unfortunately, the project did not really take off beyond the distribution and installation of personal computers (Okebukola, 1997; cited by Aduwa-Ogiegbaen and Iyamu, 2005). Okebukola (1997), cited by Aduwa-Ogiegbaen and Iyamu (2005), concludes that the computer is not part of classroom technology in more than 90 percent of Nigerian public schools. This implies that the chalkboard and textbooks continue to dominate classroom activities in most Nigerian secondary schools.

The Federal Ministry of Education has launched an ICT-driven project known as School Net (www.snng.org) (Federal Republic of Nigeria, 2006) and Adomi, 2005; Okebukola, 2004), which was intended to equip all schools in Nigeria with computers and communications technologies. In June 2003, at the African Summit of the World Economic Forum held in Durban, South Africa, the New Partnership for African Development (NEPAD) launched the e-Schools Initiative, intended to equip all African high schools with ICT equipment, including computers, radios, and

television sets, phones, fax machines, communication equipment, scanners, digital cameras, and copiers, among other things. It is also meant to connect African students to the Internet. The New Partnership for African Development (NEPAD) capacity-building initiative will be executed over a ten-year period, with the high school component being completed in the first five years. Three phases are envisaged, with fifteen to twenty countries in each phase. The phases are to be staggered, and an estimated 600,100 schools are expected to benefit. The aim of the initiative is to impart ICT skills to young Africans in primary and secondary schools, and to harness ICT to improve, enrich, and expand education in African countries (Aginam, 2006).

The Nigerian Federal Government has commissioned a mobile Internet unit (MIU) operated by the Nigerian National Information Technology Development Agency (NITDA). The MIU is a locally-made bus that has been converted into a mobile training and cyber centre. Its interior has ten workstations, all networked and connected to the Internet. The MIU is also equipped with printers, photocopiers, and a number of multimedia facilities. The Internet is provided via VSAT, with a 1.2m dish mounted on the roof of the bus. It is also equipped with a small electric generator to ensure regular power supply. The MIU takes the Internet to places like the areas around various primary and high schools (C). The buses used were few, hence most rural areas and schools have not yet been covered.

Problems Militating Against Effective Integration of Information and Communication Technologies (ICTs) in Nigerian Education

There are certain factors which hinder teacher training institutions in Nigeria from providing quality ICT knowledge and skills for trainee teachers. Some of these include lack of technically experienced lecturers; limited ICT facilities and infrastructure; inadequate course content for ICT training; lack of clear direction in the Nigerian National Policy for Information Technology (NNPIT) on teacher education; lack of leadership by professional organisations; and the problem of electricity (Zenas, 2006). These factors are enunciated as follows:-

Lack of technically experienced lecturers: Most of the lecturers in Nigerian universities, colleges of education, and polytechnics do not have competence in the use or integration of ICTs in their instruction. The majority of lecturers who have taken tenured jobs were taught without ICTs, and they have not developed competence in the use of ICTs, thus they cannot model good use of technology (Idowu, Adagunodo & Popoola, 2003). Even in the USA, faculty lecturers have been shown not to be better than their students in ICT usage (Moursund & Bielefeld 1999).

Limited ICTs facilities: Limited funds available to higher institutions have hindered the provision of needed facilities and infrastructure to promote

ICT usage. Most faculties of education and schools of education in Nigeria do not have dedicated laboratories for ICT training. Classrooms are equally not equipped for ICT usage. Thus, teacher trainers and trainee teachers do not have access to ICT within their schools. The few available ones are used mostly for administrative purposes.

Inadequate course content for ICTs: The curriculum for teacher education is centralised based on the NUC draught benchmark or NCCE minimum academic standard. The content and strategy are based on a single course model. It is meant to teach trainee teachers about the computer, not how to learn or teach using the computer. While this is good for the introductory stage, its outcomes are very limited. They cannot furnish trainee teachers with the needed skills and knowledge to integrate ICT into their instruction.

Lack of clear direction on teacher training on ICTs in the NNPIT: The national policy on information technology (FRN, 2001) is supposed to give clear directions for the successful use of ICT in schools. The policy only made superficial reference to education at the mission, goals, and strategy levels. There is no sectoral reference to education. Education is subsumed under human resource development. Since no clear information or reference is made to teacher development, the document does not give focus to teacher education in the implementation of ICTs in Nigeria.

Lack of leadership by professional organisation: In advanced countries, professional organisations like the International Society for Technology in Education (ISTE), the Association for the Advancement of Computing in Education, and Milken Exchange on Education Technology, play pivotal roles in promoting ICT integration in schools and also in setting standards for teacher training. However, professional organisations like the Computer Association of Nigeria (CAN), the National Association for Educational Media and Technology (NAEMT), computer professionals, and so on, have not impacted on the use of ICTs in schools, the promotion of ICTs in teacher education, or in setting academic or professional standards for ICTs. This lack of leadership creates a vacuum which militates against the quality ICT component of teacher education in Nigeria.

Problem of electricity: ICT equipment is electrical equipment that requires electricity for operation. Most rural areas of Nigeria do not have electricity facilities, and in urban areas, electricity supply is epileptic, and this reduces the life span of hardware and also militates against effective usage. Even enthusiastic teachers and students who have access to computers may be barred from using them as a result of power outages.

Lack of access to ICTs in trainee teachers' field experience: Practical teaching practise is an indispensable aspect of teacher education. During their field experience, trainee teachers do not have access to a technologically enriched classroom. Rather, they are exposed to classrooms where they use chalkboards to teach. This does not give trainee teachers the opportunity to explore the little knowledge gained in the area of ICT.

Computer Assisted Instructions (CAI) and students' Performance in Mathematics

Students' problems in learning and understanding mathematics vary from conceptualize-tion, speed of processing, and the use of learning strategies. Lott, and Zydney (2006) further suggested that one of the deficiencies that can negatively affect the performance of mathematics students in secondary schools is fact retrieval. In order to buttress this claim, the author further explained that, based on research findings, the ability to succeed in higher level mathematics skills is directly related to the students' ability to effectively use lower mathematics skills such as basic facts.

This assertion gives a true and undisputable picture of what prevails in the performance of students in mathematics in our schools today. Poor performance of students in mathematics cuts across both the Junior Secondary School Examinations (JSCE) and the Senior Secondary School Certificate (SSCE) examinations. This claim, in essence, could be blamed on the fact that the educational system as regards learning mathematics has failed to recognise students' altitudinal problems towards solving problems in mathematics as a subject of study. Students cannot achieve learning when inappropriate teaching methods that are at variance with their identified problems continue to apply. It therefore becomes absolutely imperative that instructional methods be varied. Computer-Assisted Instructions (CAI) have become one of the most acceptable means of learning mathematics in recent times.

According to Wiki (2008), there are many benefits to Computer Assisted Instructions (CAI). CAI functions as a set of programmes such as tutorials, drill and practice, simulations, and problem-solving approaches to present topics for learning. This method of learning also makes use of the discovery approach and games, but tutorial programmes include both the presentation of information and its extension into different forms of work, including drill and practice, games, and simulation. Drill and practise as a component of CAI provides an opportunity for students to repeatedly practise the skills that have previously been presented. Further practise is very necessary for mastery (Mautone, 2015).

The practise of CAI in learning is further shown in its programme (discovery and problem solving). In discovery, the programme is designed by the software developer to provide a large database of information specific to a course or content area. This challenges the learner to analyze, compare, infer, and evaluate based on their exploration or the data. The author also explained that problem solving as an approach to learning helps students develop specific problem-solving skills and strategies.

As enumerated by Adams (2009), there are many and quite interesting advantages of computer-assisted instruction (CAI) in learning and teaching mathematics. It provides a platform for one-on-one interaction. It acts as a great motivator. It provides freedom to experiment with different options. It creates room for instantaneous response and immediate feedback to the answers elicited. It enables self-paced learning, which allows students to proceed at their own pace. CAI also helps teachers see the need to devote more time to individual students. For those students with poor learning attitudes, CAI creates privacy that helps the shy and slow learners learn as it gives individual attention.

Ifeanyi (2002) stated that since CAI promotes self-directed learning, students decide when, where, and what to learn. And the resultant effect is that students learn more and more rapidly, having identified the weakness of the present learning methods in mathematics, which, thus far, usually results in the mass failure of students. It is quite imperative that a new and better approach be adopted to enhance students' performance. Considering the importance of mathematics, especially in the sciences and, of course, as a requisite for further courses of study in universities, the need to improve the performance of students has brought about the emerging idea of computer-assisted instruction in mathematics.

Placing the authors' postulation side by side with the students' experiment in the mathematics class, evidence abounds that students who are not doing well in mathematics have a negative attitude toward mathematics. Their lack of interest could be traced to the teachers' teaching methods. CAI is designed to arouse students' interest in learning, especially those courses of learning that have got to do with problem solving (mathematics) (Yusuf, 2002).

According to Mautone (2015), CAI has been ascertained to have a positive effect on both mathematics performance and students' attitudes toward the subject. In our society today, in fact, in all spheres of human endeavour, the computer has been accepted as a tool aimed at enhancing effectiveness by ways of easing the operation of tasks. This technological

advancement, when properly harnessed in learning mathematics in our secondary schools, can also ease learning mathematics.

In many countries in the world and many educational systems, the use of CAI seems to overwhelm the use of conventional instructional materials and methods. As a result, as advocated by Soun (2006), the ever-increasing use of computer technology in the classroom necessitates that students be as knowledgeable about computers as they are about television sets. Computers are no longer considered a technology of the future. The future has already arrived. It is imperative that educators re-evaluate their teaching methods so that CIA can be effectively incorporated into the main stream of education.

Conclusion

Information communication technology is a term used to refer to the use of computers and other related devices to organize, store, retrieve, and transmit information either within or outside an organization. ICT provides a rich global resource and a collaborative environment for the dissemination of knowledge and information. The study concludes that the various factors that hinder teacher training institutions in Nigeria from providing quality ICT knowledge and skills include lack of technically experienced lecturers, limited ICT facilities and infrastructure, inadequate course content for ICT training, lack of clear direction in the Nigerian National Policy for Information Technology (NNPIT) on teacher education, lack of leadership by professional organisations, and the problem of electricity.

Recommendation

It is very pertinent for the government to provide necessary infrastructure and training for the integration of ICTs in the secondary school system.

REFERENCES

Abolade, A. O. and Yusuf, M. O. (2005). Information and Communication Technologies (ICTs) and the Nigerian Teacher Education Programme. *African Journal of Educational Studies*, 3(1), 89-97.

Adams, K. S. (2009). Vocational / Technical Education in Ghana: Problems and Remedies. *International Journal of home Economic Research*, 20(1), 189-197.

Adomi, E. E., Okiy, R. B. & Ruteyan, J. O. (2003). A Survey of cybercafés in Delta State, Nigeria. *The Electronic Library*, 21(5), 487-95.

Aduwa-Ogiegbean, S. E. & Iyamu, E. O. S. (2005). Using information and communication technology in secondary schools in Nigeria. *Educational Technology & Society*, 8 (1), 104-112.

Aginam, E. (2006). *NEPAD scores students' ICT education in Africa Low*. Vanguard. Available at: http://www.vanguardngr.com

Ajayi, G. O. (2003). *NITDA and ICT in Nigeria*. Available: http://ejds.org/meeting/2003/ ictp/papers/Ajayi.pdf.

Barrow, E. E. (2009). *Guides to information technology*. New York: Hynes Publishing Company.

Eguaovon, O. J. (2002). *Mathematics, the heart of information technology: Implication for secondary education*. Proceeding of September 2002 Annual Conference of Mathematical Association Nigeria.

Federal Republic of Nigeria (FRN), (2001). *National Policy on Education*. Lagos: Federal Government Press.

Fubara, D. M. J. (2004). *Education Role and Policy Priorities for Rivers State and Oil Mineral Areas Development*. Education and National Development in Nigeria. Ugheli: Eddy-Joe Pub. Nig.

IBM Annual Report (1997) Cognitive style, gender, attitude towards computer-assisted learning and academic achievement. *Educational Studies*, 18(7), 151-160.

Idowu, F., Adagunodo, H. & Popoola, R. (2003). *Principles of Health Economics for Developing Countries*. Washinton, D.C.: World Bank Institute Development Studies.

Iji, C. O. & Udom, P. M. (2007). The Influence of information and communication technology (ICT) on students achievement in

secondary school mathematics. *Journal of Mathematical Association of Nigeria*, 32 (1), 66-75.

Ile, E. (2001). *Physics for WASSCE, NECO, UME and PCE*. Aba: Eric Consultant and Publishers.

Ishaya, I. B. (2003). Strategies for promoting girls interest in science and technology education at the junior secondary school: the role of the school. *International Journal of Children in Science and Technology*, 32(1), 166-175.

Isoun, T. T. (2006). *Keynote Address*. STAN Conference Proceedings in Akale, M.A.G. (ed) 3-5. Abuja, Nigeria.

James, H. (1999). *How Can Business Schools be made More Relevant*? HBS Working Knowledge.

Lott, R. O. & Zydney, J. (2006). *Technology-supported math instruction for students with disabilities*: Two decades of research and development. Washington, DC: American Institutes for Research.

Moursund, D. & Bielefeld, T. (1999). *Will new teachers be prepared to teach in a digital age*? A National Survey on Information Technology in Teacher Education. Santa Monica, CA: Milken Exchange on Education Technology.

National Education Assessment of Educational Progress, (1979). *Cooperative learning for higher education faculty*. Phoenix, AZ: American Council on Education, Oryx Press. NAEMT conference.

Okebukola P. A. O. (2004). *Science, Technology and Mathematics Education for Sustainable Development*. In: The Golden Jubilee Anniversary Conference of the Science Teachers Association of Nigeria, Sokoto.

Okebukola, P. A. (2006). Students' performance in practical chemistry: A study of some related factors. *Journal of Research in Science Teaching*, 24(2), 119-216.

Olibie, E. I. (2008). *Effect of computer-assisted language learning on students' achievement in English language*. Unpublished Ph.D thesis Nsukka University of Nigeria.

Soun, R. (2006) Self-efficacy for self-regulated learning: A validation study. *Educational and Psychological Measurement*, 68, 443–463.

Wigatap Institute of Research (2004) Becoming a self-regulated learner: An overview. *Theory into Practice*, 41, 64–70.

Wiki (2008) Investigating self-regulation and motivation: historical background, methodological developments, and future prospects. *American Educational Research Journal*, 45(1), 166-183.

Yusuf, H. (2002) *The relative effectiveness of computer and text-assisted programme instruction on students' learning outcomes in mathematics*. Unpublished Ph.D. Thesis of the University of Ibadan.

Zenas, Y. (2006) Sex Comparism of certain abilities. *Journal of Educational Research*, 57, 21 – 22.