

INFORMATION COMMUNICATION TECHNOLOGY INTEGRATION IN BIOLOGY INSTRUCTIONAL PROCESS IN SECONDARY SCHOOLS IN MIGORI COUNTY, KENYA

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This paper studied constraints to integration of Information Communication and Technology (ICT) in the teaching and learning of biology in secondary schools in Migori County, Kenya. It employed descriptive survey design that utilized stratified, simple random and purposive sampling techniques. The study targeted education officers, all the secondary schools, all head teachers, all Form Three Biology teachers and all Form Three Biology students. The study was guided by the research question; what challenges do teachers and students identify in relation to ICT integration in biology? The study used a sample size of twenty-four (24) secondary schools. Research instruments included; questionnaires for use by biology students, structured interviews for biology teachers, head teachers, CEOs and CDE, Observation schedules for biology lessons and ICT resource checklists. Data was analyzed through Descriptive and Inferential statistical procedures. The findings were presented in tables, frequencies and percentages.

Keywords: Integration, Constraints, Instructional Process, Secondary Biology

Introduction

This paper relates to capacity building through quality teacher education. Specifically, capacity building encompasses the country's human, scientific, technological, organizational, institutional and resource capabilities. A fundamental goal of capacity building is to enhance the ability to evaluate and address the crucial questions related to policy choices and modes of implementation among development options, based on an understanding of environment potentials and limits and of needs perceived by the people of the country concerned.

The problem of the study was that despite the critical role of ICT in sectors like banking, construction transport and communication, it has not been fully adopted in the teaching and learning processes in most developing countries like Kenya. While there is a wide range of innovations in ICT to support effective and quality of delivery of educational services, there is considerable technology lag in the Kenyan educational institutions. Most of the institutions still use nearly obsolete systems and consequently are unable to exploit educational potential of the emerging technologies. Information technology has played a big role in accelerating the movement of learning opportunities to all parts of the world, to learners of all cultures and nationalities. Building capacity through quality teacher education indeed forms part of this paper's recommendations.

Information technology is widely recognized as a vital resource in economic, social and political development. In the present world the skills of information technology are more than ever in great demand in all sectors including education, government, business and commerce (Rumpagapon, 2007). The importance of computers in life cannot be overemphasized as they deal with learning, employment, productivity and fun. Computers are used in banks, offices, military installations, stores, factories, schools/colleges, government agencies and even other organizations.

Biology plays a vital role in modernization, social and economic development in the world in general. It is a life science and almost all the processes in the human body involve biology. For instance we need biology in everything we do as animals for we walk, eat, sleep, and talk biology (Orodho, 1996). Students therefore interact with biology as a science in

everyday life and therefore it is expected that they show better achievement in the subject. Excellence in biology education calls for the integration of various media, technologies and techniques to teaching and learning environment. Access to a new generation of ICT has brought new opportunities to teachers and learners in the biology. However the effective integration of such applications depends on teacher's familiarity with and command of the new resources. A study on the integration of ICT in the biology classroom is therefore a valuable addition to progressive biology teacher's development. Computer users today are not computer professionals; rather, they are people who need information to do their jobs effectively.

Electronic technology was in the past very mystified. It was extra-ordinary and belonged to only the experts and specialists. Yet in the recent past there has been transformation of learning through technology in all levels, removing inhibitions, obstacles and challenges (Maleki et al, 2012). Computers have created a revolution in the production, processing and transfer of information, primarily because of their ability to handle colossal amount of data within a very short time. The main use of computers, regardless of the application area, is processing or manipulation of data fast and efficiently in order to obtain information that is complete, accurate, timely, economic and relevant.

Use of ICT in education at all levels is limited by poor ICT infrastructure, weak policy and regulatory framework, limited number of teachers who are ICT proficient, low telecommunication services penetration and poor quality services. Access to ICT facilities is presently one of the major challenges in Kenya and other African countries. The constant display of low achievement in biology is a cause of worry to many stakeholders. In fact the public outcry and concern by parents and other educationists to enhance achievement in sciences in the national examinations is clear that the challenges to integration of ICT in the teaching and learning of the sciences need urgent investigation. This poor performance in biology could be attributed to several factors such as attitude, teaching approaches/methods, content and resource mobilization and management (Musyoka, 2004). Even with the introduction of SMASSE in 1998 and the making of ICT integration a government policy, little improvement had been realized in biology performance (Jesse, 2010). Appropriate ICT instructional activities can be effective in promoting the development of logical thinking as well as the development of some inquiry and problem solving skills in learners.

ICT integration in the classroom has been widely promoted through research, activities manuals, method courses and workshops for in-service teachers in Kenya and it is a key component of student-centered instruction that leads to greater performance in the subjects (Reid, 2002). However, it is far from being universally employed by biology teachers and students in Migori County; perhaps because of the various challenges facing teachers and learners which may include insufficient infrastructure or lack of computer facilities or may be due in part to the emphasis laid by the teachers on the passive 'telling' mode of traditional lectures.

The performance of students in science subjects in secondary schools in Kenya has continued to be low for many years. Reforming and improving instruction using ICT is one way to enhance quality and relevance of science education (Ajelayami, 1990). The government of Kenya has an important role in shaping national ICT policies and encouraging education institutions to utilize new technologies to transform pedagogy, research and development as far as education development and advancement is concerned.

Modern courses in biology beside the traditional teaching methods, particularly stresses the programmed education, which allows activity of all students in all phases of the training process, and thus enables their self-learning and self-control. Programmed education as a model of flexible differentiation implies acceptance of individual skills and pace of work of each student. In methodical terms that means programming of the curricula and their manner

of treatment. Its' contents are reduced to what is relevant, logically structured in smaller parts, which are sorted by their complexity and that each student individually and gradually overcome, control results and their progress is monitored with regular feedback.

Aija and Inga (2012), state that historically the definition of ICT as educational method has been changing continuously. Famous philosophers and teachers think that educational method is; a tool in teacher's hands to promote cooperation with students, way how teacher organizes and leads students' work to knowledge, a tool that helps teacher to equip students with knowledge and skills by using intentional activity of students, a way how teacher delivers knowledge to students and leads the students' process of cognition; a way how students gain knowledge and skills, a way where teacher leads students from unknown to well-known, from no-skills to skills, a way to develop kids' possibility to think, a way of a pedagogical process where teacher leads students from unknown to well-known, a way of organizing students' process of cognition in order to provide getting the knowledge and practical skills, it is not only a tool in teacher's hands, but it is also an excellent tool to touch students' personalities.

The choice of correct ICT educational method is very important. It depends on the choice of ICT that will make a student feel bored in the lesson and the theme will slide over his brain and do not leave any knowledge or a student will perceive the theme as a game, as a part of his life and he will get the knowledge for all his life. It depends on the choice of ICT if a class will look upon the lesson as a drudgery and misbehave in the lesson or a class will be interested in the lesson and will behave well and help the teacher to lead the educational process. A possibility to judge logically, to move the correct conclusions based on the information is an integral part of ICT therefore development of students' critical thinking is one of the main tasks of a teacher.

In general, ICT integration in education carries considerable importance to shape the technology use and competencies of the future workforce. Positive experiences with ICTs help students to transfer these experiences to their own lives (Akbaba, 2006). In addition, it is not reasonable to expect learners to use ICTs responsibly and effectively if they are not exposed to relevant experiences during their training (UNESCO, 2002). Schools should be encouraged to embrace ICT integration by training various subject teachers, by providing digital educational materials for all subjects and by regularly exchanging views with school administration about ICT applications (UNESCO, 2002).

This study was expected to generate information on ICT use in teaching and learning for capacity building through quality teacher education. With changes in modern technologies learners need to be equipped with updated knowledge that will make them adapt to the changing world. Such knowledge leads to better communication and increased earnings as a result of better education and self-employment in the ICT sector. The study was also expected to generate knowledge on ICT impacts on education quality, access and challenges. It will bring to the fore the preparedness of teachers on the use of ICT right from teacher education institutions. This study was concerned with finding out the reasons as to why teachers rarely used ICT in biology teaching in Migori County.

Methodology

The study employed descriptive survey design that utilized stratified, simple random and purposive sampling techniques. Descriptive survey provided the important leads in identifying the needed emphasis and changes aimed at addressing the challenges facing integration of ICT in biology teaching and learning. It also enabled the researcher to obtain information on the challenges facing biology teaching and learning and to access the opinions of biology teachers and head teachers. Both quantitative and qualitative techniques were used. Quantitative data provided indicators of the challenges facing ICT integration in biology

instructional processes whereas Qualitative data sought to establish the options to problem solving and helped suggest the way forward.

The study used a sample size of twenty-four (24) secondary schools that was 14% of the entire population. Research instruments included; questionnaires for use by biology students, structured interviews for biology teachers, head teachers, SCEO and CDE, Observation schedules for biology lessons and ICT resource checklists. Data was analyzed through Descriptive and Inferential statistical procedures. The findings were presented in tables, frequencies and percentages depending on the research question. Responses from close-ended questions were organized, coded, converted into numbers and analyzed quantitatively using Statistical Package for Social Sciences (SPSS). Quantitative analysis gave vivid account of the situation under study, showed the relationship between variables and also attempted to advance alternative explanation derived from the data. Qualitative Analysis was used in responses from interviews and open-ended questions where some statements from interviewees were quoted verbatim. Inferential statistics specifically test of significance was used in order to determine whether the respondents' scores regarding their views towards challenges facing ICT integration in biology teaching and learning differed.

Results and Discussions

Table 1: Challenges to ICT Integration as Cited by Teachers

Challenge	Percentage
Inadequate modeling of pedagogical uses of ICT in training institutions and schools	89
Lack of electricity and other power sources in some schools	92
Limited access to computers and internet services	87
Poor ICT sustainability in schools	79
High cost of new technology content and equipment	88
Insufficient comfort with ICT use among teachers	93
Overcrowded classrooms and high student teacher ratio	78
Lack of digital content available to schools	91
Information overload and pace of change	87

From table 1 above, the following are the major constraints to ICT integration as given by the teachers.

Information Overload and Pace of Change

Our current educational system is not doing a good job in preparing students of make good use of the Global Library and other aids to information retrieval and use. In summary, the real problem that the teachers face is helping students to learn to retrieve, process, and appropriately use accumulated information. In this endeavor the teachers must deal with:

1. A continuing exponential growth in the totality of accumulated information.
2. Very rapid progress in the improvement of ICT systems and other (non-human) aids to the input, storage, processing, retrieval, and use of information. This rapid progress facilitates automation of many tasks that previously have been done by humans making use of less powerful aids.

Becta (2005), states that the effectiveness of computers has improved by a factor of more than two billion. Computerization of many different manufacturing and information processing tasks has moved us from the Industrial Age into the Information Age. The Global Library is steadily growing in size and processing power. The rapid progress in ICT is being pitted against the rapid growth in the totality of accumulated knowledge. This situation is somewhat confused by the fact that ICT is contributing substantially to the research that is

leading to the rapid increase in knowledge. Unfortunately, the education component of addressing this racing situation is not doing well (UNESCO, 2004).

Our informal and formal education system has not yet shown that it can adequately prepare students for this rapidly changing information over-load problem. Some of the reasons for this poor performance lie in the training and in-service of teacher education systems. Certainly, we have made some progress. Currently pre-service teachers now enter teacher education programs with some ICT knowledge and skills, and most own or have ready access to a computer. However, the gap between the education-related ICT knowledge and skills of newly graduated teachers and the capabilities of the field of ICT in Education is growing. ICT in education is making progress, but we are falling further and further behind in terms of pace of change in the global world. Majority of the teachers cited this as a major hindrance to ICT integration.

Lack of Technical Expertise

Excellence in education calls for the integration of various media, technologies and techniques to teaching and learning environment. Access to a new generation of ICT has brought new opportunities to teachers and learners in the sciences particularly in biology. However the effective integration of such applications depends on teacher's familiarity with and command of the new resources. A study on the integration of ICT in the biology classroom is therefore a valuable addition to progressive biology teachers' development. Lack of skills in ICT integration in biology subject could be as a result of inadequate capacity pedagogical integration of ICT, limited ICT equipment, lack of incentives from both institutions and government to encourage using ICT, or the design of the teacher-training curriculum.

Poor ICT Infrastructure and Inadequate Facilities in Schools

The introduction of ICT in resource sharing has brought about a great transformation from the traditional approach to a modern approach. Academic libraries entrusted with the heavy task of providing readers with the latest or current and retrospective materials apart from improving their inter-library loan service, should take a number of wide-scale measures to improve and reinforce international cooperation in the area of exchange of publications and international lending services (Wachira, 2005). For instance, the online catalogues of collaborating libraries can be combined to create a "union catalogue" of holdings for multiple libraries, and added components can be configured to interface with the other libraries to enhance resource sharing. Moreover, the researcher found out that biology student per computer ratio was 1:15 in most schools in the County. Accessibility to resources could be the biggest challenge to both teachers and students. To those who are able to access the few computers available, contact hours could still be an issue due to the fact that they have to use the computers on limited time.

Compounded to this is the fact that even the few resources and equipment that are available in the schools cannot be sustained due to the fact that no allocation is made by the school administrators for maintenance and repair of the ones broken down.

High Cost of New Technology Content and Equipment

Even in light of tighter budgets, heads of schools have to make purchasing interactive technologies a high priority. In addition to going out into the community to do additional, personal fundraising, they should fundamentally update their purchasing criteria to ensure they fully maximize investments. Becta (2005) argues that the school management should not even consider a tool unless it integrates with current technologies and existing environments, as well as demonstrates ability to adapt easily to future potential needs. Teachers should use creative strategies to balance the need for new, innovative classroom technologies with the reality of tightening budgets. Becta (2005) argues that good management and professional practice can overcome these difficulties since some schools do offer a good quality education.

Lack of Digital Content Available to Schools

Although from the responses teachers gave this item as a hindrance to effective utilization of ICT in teaching and learning process, most of the teachers are not able to handle most ICT resources and therefore their training in ICT skills should come first. There is no need in availing materials of digital content if they will not be used and that even their storage and safety is not assured.

Inadequate Modeling of Pedagogical Uses of ICT in Training

Most teachers claim that during their training they never witnessed ICT use that can influence and convince them to be using the same in the teaching and learning sessions. They have no experience and no exposure to ICT use in instructional process. This should not be taken seriously though due to changing times and changing nature of instructional process. The fact that others did not use or are not using ICT should not discourage teachers from doing the same.

Conclusions

The findings from the study allow for the following conclusions to be made:

1. Secondary institutions are doing their best to acquire computers and other ICT resources for teaching, learning and administration purposes.
2. Students are enthusiastic in using computers for learning despite the high student computer ratio.
3. Public education institutions have a higher student to computer ratio than private ones.
4. Teacher to students computer ratio still high in most schools across the County
5. With regard to connectivity, access rates are still high and most institutions cannot cope with high cost of connectivity.
6. There is need for policy guidelines to cover education institutions with regard to ICT equipment and connectivity.
7. ICT Integration is still inadequate, more individualized than institutionalized.
8. Schools that have embraced public-private partnerships like cyber schools technology solutions have gone a long way to integrate technology in science subjects
9. Existence of computer clubs in some schools has enabled peer learning sharing and documentation of information.

Recommendations

Based on the findings of this study, the following recommendations can be made:

1. Schools and teachers in general are advised to embrace new technologies to focus more on the design of laboratory experiments and data interpretation
2. Use ICT in combination with conventional instructional methods for improvement in biology achievement
3. In all accounts of biology teaching process, teachers should equip themselves with relevant and up to date ICT knowledge and skills for effective classroom communication.

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References

- Aija, C. and Inga, S. (2012). Use of ICT in teaching- learning Methods make school Math blossom. *Journal of Procedia- Social Behavioral Sciences* 69, 1481-1488. Retrieved from www.sciencedirect.com on 5th June, 2014.
- Ajelayami, D. (1990). *Science and Technology education in Africa: Focus on seven sub-Saharan countries*. Lagos. University of Lagos Press.

- Akbaba, A. S. (2006). Complexity of Integrating Computer Technologies into Education in Turkey. *Journal of Educational Technology and Society [Electronic]* 5(3), pp.367-369. Retrieved from www.sciencedirect.com on 8th June, 2014.
- Becta (2005). *The Becta Review 2005 : Evidence on the progress of ICT in Education*. Becta ICT Research.
- Jesse, S. N. (2010). *Computer assisted instruction and conventional instructional methods in science. A comparative study of secondary schools in Embu district, Kenya*. Master thesis. Unpublished.
- Maleki, H., Majidi, A., Haddadian, F., Rezai, AM. & Alipour, V. (2012). Effect of applying information and Communication technology (ICT) on learning level and information literacy of students. *Journal of Procedia- Social & Behavioral Sciences* 46, 5862-5867. Retrieved from www.sciencedirect.com on 5th November, 2013
- Musyoka, J. (2004). ASEI Movement and the PDSI approach. A paper presented during the 1st cycle of SMASSE project
- Orodho, J.A. (1996). Factors Determining Achievement in science Subjects at secondary level in Kenya. Doctoral Thesis, Kenyatta University. Unpublished.
- Reid, S. (2002). The integration of Information and Communication Technology into classroom teaching, *Alberta journal of Educational Research*. Vol.XLV111, No. 1
- Rumpagapon, W.M (2007). Students' critical thinking skills, attitudes to ICT & perceptions of ICT classroom learning environments under the ICT schools pilot in Thailand, PhD thesis, University of Adelaide
- UNESCO (2002). *Information and communication technologies in teacher education: A planning guide*. Retrieved October 19, 2013 from, <http://unesdoc.unesco.org/images/0012/001295/129533e>.
- UNESCO (2004). *School networkings: Lessons learned*. Bangkok: UNESCO Bangkok (ICT lessons learned series, Volume II).
- Wachira, E. (2005) "ICT in Education: A Practical Approach". In Bracey, B., Culver, T. (eds.) *"Harnessing the Potential of ICT for Education- A Multistakeholder Approach"* [Internet] United Nations ICT Task Force. Available from: <<http://www.digitaldivide.net/comm/docs/view.php?DocID=199> > Accessed 23th October 2013.