



# Integrating Computer Science Education in Kenyan Secondary Schools

**Florence Y. Odera**

Bondo University College

## ABSTRACT

For many years science educators in Kenyan secondary schools hoped that the use of science apparatus supplied by Science Equipment Production unit (SEPU) would substantially help teachers to provide students with efficient and effective opportunities to learn science, products, and processes. But this has not improved students' performances in examinations. Research findings from developed countries have pointed out the capabilities of computers to improve students' scientific knowledge. This happens when students are taught to use computers as tools for thinking, creating and adapt computers to fit their own needs such as students written simulations, science interfacing. Computers have now been available in Kenyan secondary schools for over ten years. This article presents the results of a study that investigated the use of computers in teaching and learning science in public secondary schools in Kenya. The purpose of the study was to find out if science teachers use computers to help improve the quality of science education. Related literature for this study revealed that teaching/learning science subjects with computer helps to improve students performance in examination. This study was based on a descriptive survey. The area of study was Kisumu Municipality and the study population consisted of 22 head teachers, 1200 students and 44 science teachers. Saturated sampling was used to select a sample of 20 head teachers, while purposive sampling was used to select a sample of 20 science teachers. At the same time, simple random sampling was used to select a sample of 400 students. Data was collected by use of questionnaire, document analysis guide and observation schedule. Data analysis involved use of descriptive statistics that included graphics, percentages and frequencies. The finding showed that there was inadequate provision of computers in secondary schools. Very few science teachers used computers in teaching/learning science. The study recommended that Head teachers should purchase more computers and provide adequate facilities such as computer laboratory, and trained manpower.

**Keywords:** *Science, computers, teaching/learning, improve science education*

## 1. INTRODUCTION

Teaching and learning science subjects whether in developed or developing countries requires the use of various teaching aids/apparatus. In most areas of science education, the use of technology is quite acceptable and highly recommended to enhance learning. Researchers have pointed out the capabilities of computers to improve students' scientific knowledge and stated that "Computer-based technology gives science teachers access to a rich variety of textual materials and graphic information. Woodrow (1994) explained that the use of computers provides new instructional strategies which the teacher and students can employ. This includes sophisticated laboratory and simulation tools.

Yet many science teachers shy away from incorporating technology into their teaching and learning process despite the availability of computers in the schools. Clark (2000) pointed out that few teachers used computers-based technologies for instructional purposes and observed that computers are not being integrated into most instructional curricula. Heinich et al (2002) noted that advancements in technology have now made it possible to integrate computers into the teaching of science. They stressed that the emphasis in teaching and learning should now be on providing learners with the opportunities for problem solving. This he believed should include cooperative learning methods which may not necessarily require additional special training in the part of the users. He further stated that computers are now more of a natural tool to use in teaching and learning because a

wide variety of software is available. This provides students with experiences to work together to solve complex problems. Heinich et al (2002) believes also that when the computer is integrated into the curriculum, students will be able to incorporate several different types of computer applications to explore a problem in a particular field. So the traditional method of teacher-centred instruction used by most teachers will change. The students will learn by doing which is the corner stone of all science learning. The students will also learn to explore topics in science and create meaningful learning experiences for themselves (Heinich et al (2002).

## 2. SCIENCE TEACHERS ROLE IN THE USE OF COMPUTERS

When the computer is integrated into the classroom the role of the teacher changes from that of the information provider to that of a facilitator of learning (Clark 2000). For example to integrate technology into teaching and learning science effectively, Heinich et al. (2002) suggest a very simple integration approach as an example. According to him the teacher could give students an assignment to prepare a report on ecology. A group of students would use a computer database to search for resources to use in compiling the report. They could also send electronic messages to people in various places requesting relevant information. In addition, the students could use a data base program to store and sort out their information. At the end of the



research, they could use a word processor and hyper media program to prepare a written document. Lastly the students would use a projector to display their findings to the rest of the class. In this type of computer integration into learning science, Heinich et al (2002) emphasise that the teacher must provide opportunity for learners to complete their work and learn effectively. If this strategy is to be effective, the teacher needs to plan in advance to integrate the computer into teaching and learning, prepare good learning environment for the students, and work in collaboration with the students during the research period. After the presentation the teacher could organise for a science quiz session for all students or give further assignment.

In another instance, Christman and Budgett (1999) carried out a comparative study to evaluate the effectiveness of CAI on the Science achievement of American students following two different teaching methods. The assessment covered four subject areas, general science, physics, chemistry and biology. The participants were drawn from urban, suburban and rural secondary schools. The sample included a total of 2343 students. The purpose of the study was establish the differences that existed between the academic achievement levels of science students who used computer assisted instruction, and those who used traditional approaches to learn biology, general science, chemistry and physics. The experimental group that used systematically designed traditional instruction supplemented with CAI obtained significantly better academic achievement compared to the control group that adopted a conventional teaching approach. Further result indicated that CAI was more effective among science students living in urban areas followed by those in suburban and those from rural areas had the lowest test score. In conclusion, Christman and Budgett (1990) appealed for more research to establish whether CAI could be more effective or ineffective among groups of students or within certain academic areas so as to support effective use of CAI in science subjects.

Similarly, McRobbie and Thomas (2001) conducted an experimental study to investigate the factors that influenced teachers and students to use microcomputers based Laboratory technology in chemistry lessons. The participants were drawn from an independent high school located in a Metropolitan city in Brisbane Australia. The sample of the study consisted of 12 males and 9 females (15-16years) studying chemistry as part of a general science course in year eight, nine and ten. The researcher used two types of experiments that involved the use of MBL and covered topics such as: boyle's law, pressure-volume relationship in gases, and pressure-temperature relationship in gases. These scholars used video recordings, tape recording and face-to-face interviews to collect data. At the end of the experiment the data were analysed and the results showed mixed responses. In the first place, the subject teacher supported the use of MBL to learn science but was not ready to change her methods of teaching science. She believed in a

teacher centred approach and was not comfortable with learner-centred approach that s computer based. However, for the integration of computer to be effective, the researcher must be able to use the technology. Once the teacher is comfortable with technology, the students will also be willing to use the computer because they will have seen the teacher using it in teaching them. The experience of the teacher is also an important factor to consider. In this experiment the teacher was not trained in computer applications and did not regard the technology as potential medium to improve student's scientific knowledge. Therefore, for any meaningful learning to take place in an innovative venture like the use of MBL, the role and experience of the teacher needs to be examined carefully. The implementation of computers in education cannot be effective if teachers are not ready for using the technology.

### 3. EFFECTIVE UTILIZATION OF TECHNOLOGY

Although computers have been widely recognised as a potential tool for teaching and learning science subjects, the effective utilization of the program is required if students and teachers are to benefit. Hargrave and Kenton (2000) feel that what has been lacking is instructional methods that take advantage of the computer and engage students in advanced way of thinking. The educational value of computer programmes depends on many factors in a similar way to traditional instruction. Some of these factors include: the content of the program, its relevance, the teacher's ability to use and guide the students, student's own ability and interest to learn, and the difference application techniques employed by the teachers.

Hargrave and Kenton (2000) report some procedures to be followed in which the teacher's role is only to guide the students, prepare the learning environment and take part in the program with the students. They highlighted specific values attached to effective ways of using a computer simulated laboratory that involves preparatory activities on the part of the teacher, pre-instructional simulations and post instructional simulation.

According to Hargrave and Kenton (2000), computer simulations are used to teach students many topics in science subjects, because the mental and physical dexterity required the use simulation that engages students in learning. Hargrave and Kenton (2000) add that simulation is often used to stimulate students's interest in a topic in order to promote active learning of problem solving and the study process. As such, computer simulation has been employed in science education to teach students about cardio-vascular circulation, fire, heat, velocity and electricity. All these require careful planning and preparation by the teacher in advance. Effective use of computer-simulation depends upon the teachers ingenuity in bringing to bear on the materials those aspects of their student's experience that make the program important and significant to them. Hargrave and Kenton (2000)



recommend that when the teacher plans to use computer simulations the students should first learn the content of the lesson. They suggest that the teacher needs to use appropriate traditional teaching methods such as lecturing to present the essential important information to the students. Then the computer simulation is used either to supplement the content or to reinforce what the teacher has taught. The scholar also believed that an appropriate computer simulation could be the main source of information and understanding for students.

## 4. METHODOLOGY

### The Research design

The study used descriptive survey design. Descriptive survey focuses on determining the status of a defined population with respect to certain variables. Its primary advantage is that the researcher can gather a great amount of data in a short period of time (Borg & Gall 1996). As such, a descriptive survey design was considered appropriate for this study because the research focused on the use of computers to improve science education in secondary schools. The descriptive survey encompassed both qualitative and quantitative methods of data collection and analysis. The questionnaire, lesson observation, interview schedule were primarily used to get responses from participants. The research aimed at providing accurate information and characteristics that are observable in science teaching in secondary schools in Kisumu municipality.

### Study location

The study was carried out in Kisumu Municipality. It is one of the districts in Nyanza province, Kenya. Administratively, the municipality falls in Kisumu County. The Municipality has 13 locations and is located on the eastern shores of Lake Victoria. It borders Vihiga and Nandi districts to the north, Nyando district to the east, kadibo division to the southeast and Maseno division to the west. Kisumu municipality has 28 public secondary schools in Kisumu west District (District Education Office 2006).

The district has in the recent past improved in performance in the KCSE examination. The schools have also fairly improved in physical facilities funded mostly through the constituency development fund (CDF).

### Study Population

The study population consisted of 24 public secondary schools. It involved 1680 focused on 28 secondary schools in the municipality. It consisted of 1680 form four students, 44 science teachers, and 24 head teachers in all the public secondary schools in Kisumu municipality.

### Sample and sampling techniques

Simple random sampling method was used to select a sample of 400 students from the total of 1412 students representing 28% of the study population. Saturated sampling was used to select the principles of the 20 schools and 20 Science teachers. Saturated sampling is a non-probability sampling procedure in which all the members of the targeted population are selected because they are too few to make a sample of them (Borg & Gall 1996). Simple random sampling was used to select 20 form three science students from each school that had computers.

### Data Collection Procedure

The researcher personally visited all the sample schools and administered the questionnaire, and conducted the interviews. Correction and clarification were made during the interaction with participants as need arise. The researcher also observed the lessons being taught using the lesson observation guide.

### Data analysis

Data for the study was obtained from questionnaires and interviews and observation responses. Data collected using questionnaires were analysed using descriptive statistics. Responses from the questionnaires were tallied and converted into percentages. Data collected from interviews were transcribed and organised into themes, categories and sub-categories as they emerged during the study. The responses were tallied and converted to percentages. However, the information obtained from observation were organised and presented qualitatively. The overall finding of the study was presented qualitatively and quantitatively.

## 5. RESEARCH FINDINGS

The main objective of the study was to find out whether science teachers were integrating computers into subject topic areas such as science. The findings indicated that most of them had not integrated computers into their general teaching and learning process, but one of them responded that if I am using computers during science class, I may make reference to the topic then the students look at it in the computer at their own time. Some of the interviewees reported also that they inform students about the programs containing information relevant to a subject like chemistry then the students look the information in the computer to learn about it. Still another teacher reported that "I use the computer to revise and summarise what I have taught by showing some skills in different science subjects like Biology, Physics and Chemistry. However, after summarising the findings, the results showed that 25% of the science teachers used computer as part of the main lesson held in the computer lab. Another



20% integrated computer into some topics and this forms part of the lesson presentation. About 30% integrated the computer to introduce the subjects by using allowing the students to computer search for information related to topic to be discussed first before meeting the students. The other participants 10% indicated that they use the computer to summarize what they have taught while 40% of had not integrated computers into teaching and learning science subjects.

These finding support the earlier study by Liu, Macmillan and Timmons (1998) who noted that integrating computers into the classroom has to take teachers personal and professional constraints into consideration. Most of the teachers interviewed had not been exposed enough to computers and were not able to integrate the technology into teaching and learning science. Another study by Ertmer et al. (1999) showed that full integration of computers into the educational system was a distance goal unless teachers are trained, competent and are willing to use computers in teaching and learning traditional subjects. Myhre (1998) also believed that the teachers' use of computers could vary tremendously depending on the teachers' experiences, knowledge and beliefs.

### **Benefits of using computer in teaching and learning science**

70% of the teachers believed that the use of computers helps to increase students' scientific knowledge of science subjects. But 10% were not sure, while 20% of the teachers noted that with use of the Internet, students' access information on different subjects from various libraries or data bases. A male biology teachers from rural answered yes....it increases students' knowledge of how for example cancer spread in the body, when students look at how the cells move around. It gives them a clear understanding of the topic. This helps them to do more research and increase their knowledge of science subjects they learn in class. A similar study by Kibos (2000) in Kenya indicated that the student's treatment group learned the concept and methods in physics better than their counterparts in the control group. Christman and Budgett (1999) reported similar findings.

### **Motivating students to learn difficult science topics**

50% of the interviewees reported that computer highly motivate students to learn. A science teacher from urban school noted that students are eager to learn with computer and are eager to learn new ideas. It challenges them to search for the information on various scientific items. The results supports Heinich et.al (2002) encouraged the use of technology to motivate learners and noted that students who are intrinsically motivated will work hard and learn more because of their personal interest in the materials. For example, one teacher from

suburban school reported that the use of computers have really increased my students desire to learn. They are normally very motivated and this enables them to learn and understand difficult science topics. A teacher of science also reported that as a result of using computer my students improved in Biology because the computer gives vivid information that incorporates visual aids. A study by Kibos (2000) on the use of computers to learn Physics supports the findings since the study indicated significant improvement in students learning.

### **Increasing students' attention to learn**

85% of the teachers stated that the use of computers help to increase students' attention to learn science. One teacher from urban school noted that "in human anatomy the diagrams are so detailed and well drawn to attract the attention of the students, Another one said yes ...in Physics w teach electronics, this enables students to do practical experiments involving electricity without necessarily going to the conventional laboratory....it supplement the existing Physics curriculum. Still another teacher commented.... you see in science....especially in Physics there are programmes closely related to artificial intelligence which forms the basis of computer science. However, a few of them 15% noted that teachers must be with the students for them to be attentive to learn otherwise some students will be talking or discussing and not paying attention.

### **Teacher training in the use of computer**

Out of the 20 interviewees 95% confirmed that they hard received some kind of training in computer literacy courses. At the same time they also reported that the training was for a very short period which did not include learning how to use computers in teaching and learning traditional subjects. There was therefore the need for retaining the teachers to use computers in teaching different subjects in secondary schools. The findings on this issue very few 55% had not attended any in-service courses. A study by Ayere (2009) found that a great deal of teachers had not attended any in service training on traditional subjects. It is important that all teachers should be re-trained in any curriculum innovation. Such staff development courses contribute a great deal to teacher's professional development. Re-training program for teaches also enables them to gain practical ideas about using computers in the classroom. Teachers should also be trained in the design of packages to simplify it for students

## **6. CONCLUSION**

This study was conducted to find out if science teachers use computers in teaching/learning. The objective of the study was to provide evidence that science teachers integrated computers into teaching and learning science. The findings indicated that a great deal of science teacher



had not integrated computers into teaching and learning science subjects. However, the majority of them valued the use of computers in learning science and inform students to look for relevant science topics as they carry out computer literacy study. The study further established that students learn science subjects. A male biology teacher from rural school reported that computer increases student's knowledge of how cancer spread in the body. Despite the value of using computers in science education the study established that very few teachers were trained in computer skills. The study recommends that science teachers should be trained on the skills required to integrate science subjects into the teaching of science subjects.

## REFERENCES

- Ayere, M. (2009). A comparison of Information and Communication Technology Application in NEPAD and NON-NEPAD schools in Kenya. Unpublished PhD Thesis: Maseno University.
- Borg, W.R. & Gall, M. D. (2007). Educational Research: An Introduction. (6<sup>th</sup> Ed. New York Longman
- Clark, K.D. (2000). Urban Middle school Teachers' use of Instructional Technology. *Journal of Research on Computing in Education* Vol. (1), pp124-131
- Christman, E. & Badgett, J. (1999). A comparative analysis of the effects of Computer-Assisted Instruction on students achievement in different Science and demographical areas. *Journal of Computing in Mathematics and Science Teaching*, 18 (2) 135-143
- Fraenkel, J. R. & Walker, N. E. (2000). How to design and Evaluate Research in Education (4<sup>th</sup> Ed). San Francisco: McGraw Hill
- Hargave, C. P. & Kenton, J.M. (2001). Pre-Instructional Simulations: Implications for Science classroom teaching. *Journal of Computers in Mathematics and Science Teaching* 19 (1), 47-58
- Heinich, R. Molenda M. Russell, J.D.& Smaldino, S.E. (2002). *Instructional Media and Technology*. New Jersey: Prentice hall
- Kibos, J. K. (2000). Teacher/Pupil on computer Augmented Physics lessons on measurement in Kenyan Secondary Schools. *Journal of Information Technology for Teacher education*.9 (2), 199-215
- McRobbie, C. J. & Thomas, G. P. (2000). Epistemology-based and contextual issues in the use of Microcomputers-based laboratories in a year ii Chemistry classroom. *Journal of computers in Mathematics and Science teaching* 19 (2), 137-160
- Odera, F. Y. (2000). A Study of Computer Integrated Education in Secondary schools in Nyanza Province, Kenya. Unpublished PhD Thesis. University of Pretoria, South Africa
- Sadker, M. P.& Sadker, D. M. (2000). *Teachers, Schools and Society*. New York: McGraw Hill.
- Woodrow, J.B. (1994). A Computer-Based multimedia Science Education Course. *Technology and teacher Education Annual*. Washington: AACC