SCHOOL MANAGEMENT'S AND TECHNICAL SUPPORT TO PHYSICS TEACHERS AND STUDENTS IN USE OF ICT IN TEACHING AND LEARNING

Makanda J. Livingstone
Kenyatta University
makandajohn@gmail.com

Nicholas W. Twoli
Kenyatta University
nicholastwoli@gmail.com

Samson R. Ondigi
Kenyatta University
ondigi@yahoo.com

Information and Communication Technology (ICT) is beginning to be recognised as one of the major instructional components especially in science subjects. This study sought to investigate the status of ICT in the teaching and learning of physics in secondary schools. Among other objectives, it investigated management's and technical support given to physics teachers and students. It was conducted in Kimilili District, Bungoma County, Kenya. A descriptive survey design was adopted. The target population comprised 23 secondary schools in the district out of which 11 schools that have had computers for at least three years were selected using a combination of stratified, purposive and random sampling procedures. This study involved 11 secondary school principals, 30 physics teachers and 250 Form Three students comprising 83 girls and 167 boys. Questionnaires, interview guide, lesson observation schedule and document analysis guide were employed in data collection. Data collection was preceded by a pilot study mainly to determine the validity and reliability of the instruments, which gave Cronbach's alpha coefficient of 0.85 and 0.78 for Physics Students' Questionnaire and Physics Teachers' Questionnaire respectively. The data collected during the study was analysed using Statistical Package for Social Sciences (SPSS) version 17.0. Descriptive statistics comprising frequency counts, percentages, means and correlations were utilised in the analysis of the data. It was found that management and technical support was moderate; mainly in the provision of ICT facilities and employment of computer teachers respectively. The use of ICT in lesson delivery was low due to factors such as inadequate facilities and lack of appropriate ICT skills among others. This study recommends sensitization of school managers on importance of ICT, the need to invest more in ICT- skills in teachers and lastly, invest in basic ICT- resources.

Introduction

The use of ICT in teaching can be a relevant and functional way of providing education to learners that will equip them with skills and knowledge required to function in the 21st century. It is against this background that the Government of Kenya (GoK) in various policy documents has articulated the importance and the role ICT could play in education particularly in science and mathematics education. The National ICT Policy was promulgated in January 2006 and the Kenya Government committed itself to improving the quality of teaching and learning through the use of ICT in schools, colleges, universities and other educational institutions (MIC, 2006). In order to achieve this, the government came up with several strategies.

First, the GoK undertook to facilitate public-private partnerships to mobilize resources in order to support e-learning initiatives through collaboration between the government and the private sector. Through *computer for schools project*, a number of schools in every district received twenty computers at a subsidized cost. Moreover, through the Economic Stimulus Programme (ESP), the government equipped 1050 schools with ICT facilities (GoK, 2010). Besides, a number of schools have acquired ICT facilities through funding from the constituency development fund (CDF), Board of Management (BoM) and Parents Teachers Associations (PTA). At the time of this study, there were 16 out of 23 schools with computers in Kimilili District. Secondly, the GoK mandated Kenya Institute of Curriculum Development (KICD) to digitalise the secondary school science content and avail it to schools (Ratemo, 2009).

Thirdly, the government has come up with strategies of training education managers and teachers on the use of ICT in school management and classroom instruction respectively. The GoK in collaboration with Flemish Association for Development Cooperation and Technical Assistance (VVOB) has set up a National ICT integration center located at University of Nairobi -Kenya Science campus (Wakhaya, 2010). One of the activities of this center, in partnership with Center for Mathematics Science and Technology Education in Africa (CEMASTEA) is to train teachers on ICT integration in mathematics and science education. Through this arrangement, over ten thousand (10,000) science and mathematics teachers have been trained (CEMASTEA, 2012). In teacher training colleges and universities, ICT is offered as a service subject under the education and communication technology. This is aimed at equipping the teachers with requisite skills and knowledge to use ICT as a tool for effective classroom instruction. In addition, the GoK through Kenya Education Management Institute (KEMI) has facilitated the training of the secondary school principals on the use of ICT in school management. This is aimed at ensuring that the school principals are computer literate and use ICT in managing their institutions effectively and efficiently since this has a bearing on performance.

Despite all these efforts, there are concerns over how ICT is being integrated in the teaching and learning process especially for the benefit of the learners. The art of integrating ICT into teaching and learning is a complex process whose success depends on a number of factors. These factors may generally be categorised into teacher factors and school factors. Teacher level factors include: teacher's confidence in using ICT tools, teacher's competence and training, teacher's attitude towards use of technology and teacher's experience, among others. School level factors include: management and technical support in use of ICT tools. The findings of this study could be useful in informing stake holders in education about the status of ICT facilities in schools and the support given to physics teachers in integrating ICT in their lessons

Methodology

A descriptive survey research design was employed in this study. Data collection was obtained using questionnaires, observation schedules, document analysis and interviews. In this study, the independent variables are teacher and school factors in secondary schools that influence the use of ICT in teaching and learning of physics. Teacher factors include: teaching experience, teacher competence in ICT use, teacher experience in using ICT and teachers' attitude. School factors include: technical and management's support, and school policy. The dependent variable is 'the use of ICT in teaching and learning of physics.' Location of the study was Kimilili District, which has two groups of schools: public and private. All the public secondary schools were targeted because of their direct support by the government and hence they are bound to have some basic ICT facilities. The study sample comprised schools that have had computers for at least three years. The expectation is that teachers, students and management in the schools have had adequate time to interact with the computers.

A total of 11 out of 23 public secondary schools that have had computers for some time were sampled for this study using stratified, random and purposive sampling techniques. These comprised of a national school, four county schools and six district schools, representing 47.8% of the total number of public secondary schools in the district. A study sample in the range of 10-20% of the total population is acceptable as a sample in descriptive research (Ary et al., 1972). A total of 250 out of 698 form threes comprising of 85 girls and 165 boys, representing 35.8% of physics students in the district were sampled for this study. Thirty physics teachers (71.2%) and eleven school principals (47.8%) participated in the study. Table 1 shows the study sample.

Table 1: Sample for the Study

	Total	Sample	%
Number of secondary schools in Kimilili District	23	11	47.8
Number of Physics teachers in Kimilili District	41	30	71.2
Number of Form 3 physics students in Kimilili District	698	250	35.8
Number of school Principals in Kimilili District	23	11	47.8

Source: DEO Kimilili District, (2013)

In this study, questionnaires were used to collect information from the physics teachers and students. The researcher used this tool because of its objectivity and also the data generated is quantifiable ready for statistical analysis (Saunders et al., 2007; Mugenda and Mugenda, 1999).

Interview guide was used to collect of data from the school principals who are often quite busy and may not have adequate time to respond say to a questionnaire. In addition, it is a flexible tool for data collection, enabling multi-sensory channels to be used: verbal, non-verbal, spoken and heard. While regarded as powerful, an interview schedule can also be open to bias if not administered professionally.

In order to verify information obtained through self-reporting by respondents, lesson observation guide was used to gather information on the use of ICT when teaching physics. Data gathering through observation entails observing people's behavior so as to get information about phenomena of interest (Johnson and Christensen, 2004). Lesson observation tool provided information on teacher's level of using ICT in the classroom. This is an important tool because it provides information about the actual behavior of those under observation.

The research also utilised document analysis to gather data. Among the documents analyzed were schemes of work, lesson plans, and store ledgers. This was to ascertain whether physics teachers utilise ICT tools in preparation of documents such as schemes of work, lesson plans and lesson notes, among others. In addition, the tool was used to ascertain if the teachers plan with ICT tools in mind. Stores ledgers were analysed to ascertain the availability and management of ICT tools and facilities.

Piloting was conducted to determine the reliability and validity of the research instruments. To ensure construct validity, the clarity of the items and level of language were checked in consultation with the researcher's course supervisors and ICT specialists. The reliability of the Physics Teacher Questionnaire (PTQ) and Physics Student Questionnaire (PSQ) was determined by calculating Crombach's alpha using SPSS. The alpha coefficient of reliability was found to be 0.85 and 0.78 for PSQ and PTQ questionnaires respectively. According to Mugenda and Mugenda (1999), if the value of r is 0.6 or greater, then the data obtained is reliable. The presentation and interpretation of the analysed data was done using tables and figures under the following headings: background information, management's and Technical support,

Results

Background Information

The background information regarding the physics teachers, students and principals of the sample schools is presented in this section.

Teachers

Gender. The results indicated that 13% and 87% of the physics teachers in the sample schools were females and males respectively. This skewed ratio is a reflection of the low population of girls pursuing physics to higher levels of education.

Professional qualifications. This study showed that all physics teachers in the sample schools are professionally qualified with 60% and 13.3% having Bachelors and Masters Degrees respectively. This is an important aspect since according to Allison (1997) skilled and knowledgeable workforce is closely linked with successful implementation of technology.

Teaching experience. Teachers' teaching experience was considered in a range of five years (Table 2).

Table 2: Teaching Experience of Teachers in Years

Teaching experience	Frequency	%	Cumulative %
Below 5 years	6	20.0	20.0
Between 5 and 9	9	30.0	50.0
Between 10 and 14	7	23.3	73.3
Between 15 and 24	8	26.7	100.0
Total	**30**	**100.0**	

The results showed that the majority of the teachers have a working experience of above five years. Long experience of teaching a particular subject is important because it could contribute to good content mastery and confidence in the teacher.

Experience in using computers. Teachers were asked to indicate their experience in handling computers in one form or another. The findings are summarized in table 3.

Table 3: Physics Teachers' Experience in using Computers

Experience in computer use	Frequency	%	Cumulative %
Below one year	7	23.3	23.3
1-2 years	4	13.3	36.7
3 to 4 years	9	30.0	66.7
More than 5 years	10	33.3	100.0
Total	**30**	**100.0**	

It was observed that 43.3% of the teachers in the study sample have interacted with computers for between one and four years while 33.3% have computer experience of more than five years. This is regarded as good enough to venture in IT-integration if given support.

Training on how to use computers and integrate in teaching and learning of Physics. Training is a useful component when it comes to skill development. Findings indicated that a good proportion (70%) of the teachers in the sample schools have been trained on general use of computers. The study also showed that 60.0% of the physics teachers in the sample schools have been trained on how to integrate ICT in the teaching and learning of physics. Such training is said to be effective if teachers are able to use ICT in teaching physics in the classroom.

However, different institutions with varying training contents have offered the workshops. Some of the teachers indicated that they were trained through SMASSE INSET, others through the HP program being implemented by Kenyatta University, while others attended Intel teach course sponsored by Intel Corporation and implemented by trainers drawn mainly from CEMASTEA. This kind of uncoordinated arrangement is likely to give packages which lack harmony and hence ineffective.

Students

Physics students experience in using computers. The main focus of this study was the students. This formed a total of 250 from 11 secondary schools. A total of 250 Form three students, comprising 34% female and 66% Male responded to PSQ. This ratio, which reflects the population of physics students by gender in the district, suggests that there is still a disparity among students pursuing physics to higher levels. Physics has been perceived for a long time as a male domain. The study showed that 82.0% of Form Three physics students in the sample schools have interacted with computers as compared to only 18.0% that have never. This means that most students have an opportunity to access a computer either at home or cybercafé for those who can afford, or at school. The fact that some of the students have never handled computers could mean lack of proper policies in some schools that would ensure that every student could access computers (Table 4).

Table 4: Physics Students' Experience in Using Computers

Experience in computer use	Frequency	%	Cumulative %
None	45	18.0	18.0
Below one year	43	17.2	35.2
1-2 years	74	29.6	64.8
3 to 4 years	42	16.8	81.6
More than 5 years	46	18.4	100.0
Total	**250**	**100.0**	

Students' experience in using the Internet. Internet is an important ICT tool for communication, conducting research and entertainment. The students were required to indicate how long they have used Internet for whatever purpose (Table 5).

Table 5: Physics Students' Experience in Using Internet

Experience	Frequency	%	Cumulative %
None	26	10.4	10.4
Below one year	113	45.2	55.6
1-2 years	40	16.0	71.6
3 to 4 years	39	15.6	87.2
More than 5 years	32	12.8	100.0
Total	**250**	**100.0**	

A large percentage of 89.6% of the students have used Internet. This proportion is higher compared to those who have interacted with computers (82.0%). This could mean that the students access Internet using other ICT tools such as mobile phones and I-pads among others. Exposure of students to computers is a useful step for teachers to capitalize on when it comes to integration of IT-in instruction.

Secondary School Principals

School Principals' facilitation. School principals can play a very important role when it comes to formulation and implementation of school ICT policy as well as supporting teachers and students. Information was sought from 11 school principals mainly through face-to-face interviews.

Working experience of school principals and IT support. Effectiveness and efficiency of a principal in managing a school could depend on his or her working experience because of leadership skills gained over time. The focus of this item was on the number of years one has been a principal (Table 11). A high percentage of 72.7% of the school principals

in the sampled schools had working experience of more than 5 years. Long working experience is good because a principal will be able to understand, articulate and implement Government of Kenya (GoK) ICT policies better.

The principals were required to state whether they have attended any formal training in computer use. This is considered important because a principal who is computer literate could easily use knowledge and skills gained to guide other teachers on the same. Six out of eleven principals were trained (Figure 1).

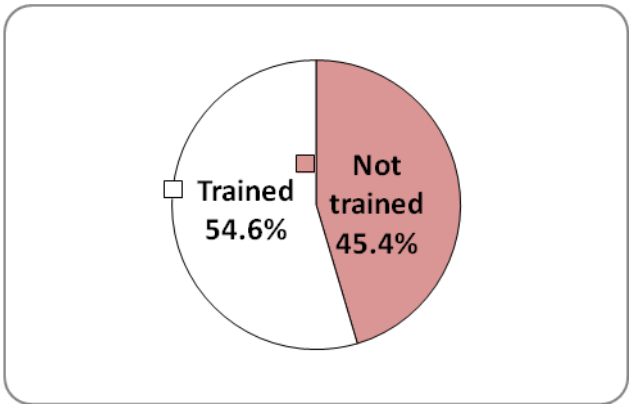


Figure 1: School Principals Trained in Computer

The findings showed that 54.6% have been trained on computer use. The others (45.4%) have learned how to use computers on their own. The encouraging aspect is that nearly all principals are computer literate, an aspect that they can use to promote IT in schools.

School management's and technical support to physics teachers and students in use of ICT in teaching and learning. Management support refers to the support given by the school principal and the entire administration to teachers and students. It is important because it is at this level where decisions on implementation of new policies such as adopting new educational innovations are made. Technical support is equally important because teachers could relax on using computers when they are not sure of where to get assistance when something goes wrong.

Information on school management's and technical support was gathered through, Physics Student Questionnaire and Principals Interview Guide. Using questionnaires Physics Teachers Questionnaire and Physics Students Questionnaire, teachers and students were required to rate the extent to which they experience certain challenges with regard to use of ICT in the teaching and learning of physics using; *very great*-4, *great*-3, *little*-2, *very little*-1, *Not at all*-0. The mean score (x) was calculated and interpreted based on the guide; $2.5 < x \leq 4$ for *low support*, $2 < x \leq 2.5$ for moderate *support* and $0 \leq x \leq 2$ for *effective support*. In addition, the respondents were required to indicate how many hours per week computers are accessible to them.

Also the school principals were interviewed on the kind of support they give to both the teachers and students in integrating ICT in teaching and learning of physics.

Challenges faced by teachers and students when using ICT for institutions. The summary of findings is given in table 6.

Table 2: Challenges Faced by Teachers

Challenge	N	Mean (Max = 4)
Lack of clear plan to access computers in the school	30	1.83
Slow Internet	30	2.40
Inadequate time to use computers in class	30	2.27
Frequent power failure	30	2.23
Inadequate number of ICT tools	30	2.53
Break down of ICT tools	30	1.90
Slow and old computers	30	1.90
Lack of technical support	30	2.37
Overall mean		**2.18**

The study showed that management and technical support as reported by teachers is moderate (**Mean =** 2.53). One of the major challenges being experienced is inadequate ICT facilities. Students were also asked to indicate the challenges they experience in the use of ICT in learning physics. Table 17 shows the findings based on Physics Students' Questionnaire.

Table 73: Challenges Faced by Students

Challenge	N	Mean (Max = 4)
Lack of clear plan to access computers in the school	250	2.14
Inadequate time to use computers in class	250	2.10
Frequent power failure	250	1.72
Inadequate number of ICT tools	250	2.00
Break down of ICT tools	250	1.50
Slow and old computers	250	1.58
Lack of technical support	250	1.89
Overall mean		**1.85**

The management and technical support in the use of ICT in teaching and learning of physics is moderate as reported by students. The major challenge being experienced is inadequate ICT facilities (mean = 2.00), which is in agreement with what teachers reported. This was also alluded to by the school principals. Indeed, a comment by the principal in school D illustrated this challenge:

> We are grateful to GoK for providing us with basic ICT facilities, but they are inadequate due to large number of students in our schools occasioned by free day secondary education. For example, in my school, I have almost 1000 students who share 20 computers. I'm appealing to all stakeholders in education to continue supporting us in this area.

Lack of clear plan by the schools for the students to access ICT facilities especially computers, inadequate time to use computers in class, slow Internet and lack of adequate time to access computers were also cited by both the teachers and students as other barriers to ICT uptake in schools.

Number of hours computers are accessible to physics teachers. This was considered important as it determines the experience being gained by the teachers, which in turn could affect the adoption rate of ICT in the schools. Table 8 shows the results.

Table 4: Hours Per Week Computers are Accessible to Teachers

Number of hours	Frequency	%	Cumulative %
None	2	6.7	6.7
less than 1	3	10.0	16.7
1 to 2	6	20.0	36.7
3 to 4	6	20.0	56.7
More than 5	13	43.3	100.0
Total	**30**	**100.0**	

The study revealed that 43.3% of teachers access computers for more than 5 hours per week. Thirty percent of them access computers for less than two hours per week. This time is insufficient for teachers to prepare ICT integrated lessons using computers. According to Sicilia (2005), teachers take much more time to design projects that include the use of new ICT than to prepare traditional lessons. Few of the teachers (6.7%) hardly access computers. These limiting ratios could mean that they are not keen or there is inadequate support by the school.

Most of the physics teachers (66.7%) teach between 20 and 24 lessons per week. This is below 27 lessons per week recommended by Teacher's Service Commission (TSC) and such a load can be considered modest. Teachers would be expected to use this advantage to learn ICT skills and plan for integration. However, this appears not to be the case. This could be due to inadequate ICT facilities, lack of interest by the teachers or lack of requisite skills to integrate ICT in teaching of physics, among other reasons. It is a common misconception that access to technology on its own motivates teachers to incorporate it in their teaching.

Support by school principals. A total of 11 school principals were interviewed and the results are shown in table 9

Table 9: Support by School Principals

Variable	No. Of school principals	%
Implementation of school policy on ICT integration	7	63.6
Employment of a computer teacher	11	100
Acquisition of ICT tools	5	45.5
Facilitation of training of teachers on ICT integration	3	27.3

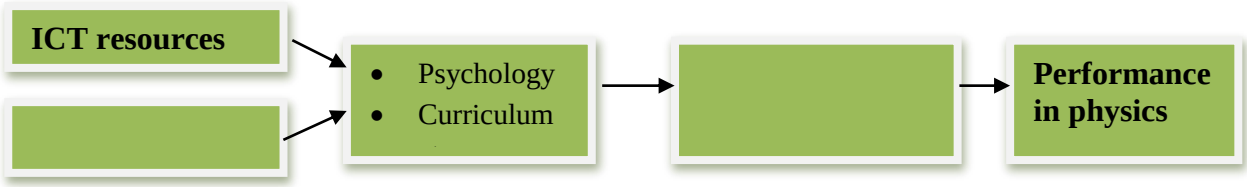
The study results indicated that 63.6% of the schools have some form of policy to support ICT use in teaching and learning. The policies were in form of dos and don'ts. For example, teachers are required to type schemes of work, lesson plans and tests before handing them in. In school B, the principal said:

> The workload for my secretary has now reduced since I introduced the policy requiring that all teachers type their own schemes of work, lesson plans and examinations. I have placed computers in each department as well as in the staff room to facilitate my teachers in this. I have also placed computers in the library with e-content in biology, chemistry and physics. On average, fifty students and at least eleven teachers access them daily.

The remaining 36.4% of the schools did not have any policy on ICT use in teaching. The principals of all the sample schools had computer teachers employed either by TSC or BoM. Computer teachers come in handy in assisting other teachers on technical issues. Only 27.3% of the school principals had taken some initiative to have their teachers trained on how to integrate ICT in teaching. From the responses, one can conclude that the principals are making quite an effort to promote ICT in teaching and learning.

The School as a System

A school is a system with inputs and outputs. The inputs include ICT resources, physics teachers among others. For ICT to have an impact on performance in physics, the school management must play their roles well i.e. put in place policy, facilitate training of teachers and provide conducive environment that promotes use of ICT in teaching and learning.



Conclusions and Recommendations

This paper presented an investigation of ICT integration in the teaching and learning of physics in secondary schools in Kimilili district. It revealed that ICT tools such as computers were mainly used for typing of lesson plans, schemes of work and analysing students' test scores. However, ICT use during lesson delivery was minimal. ICT will benefit both the learners and teachers if it is made use of during lesson planning, lesson delivery and in assessment.

The study established that management's and Technical support in sample schools is moderate, Technical and administrative support encourages teachers to successfully use ICT in classrooms. According to Yee (2000), a leader who implements technology plans and also shares a common vision with the teachers stimulate them to use technology in their lessons. This study established that physics teachers do not have adequate time to plan ICT integrated lessons since access to ICT facilities within the schools is limited to one hour or less per day probably due to limited ICT facilities.

Successful integration of ICT in teaching and learning requires support of all stakeholders specially school management. It is therefore recommended that school managers should provide more ICT resources, which were found to be inadequate in most schools. It is also recommended that school principals be sensitised on the importance of ICT in teaching and learning. Lastly, it is also recommended that school managers should invest more in ICT facilities.

References

Ary, D., Jacobs, L., & Razeriah, A. (1972). *Introduction to Research in Education*. Holt, Reinhart and Winston, New York.

Allison, L. (1997). *Factors which, potentially, will enable teaching staff to make more effective use of ICT for learning and teaching*: Centre for Academic Practice, University of Strathclyde, Glasgow G1 1QE. Retrieved on 20th January 2014 from https://www.google.com/#q=Allison+%281997%29+and+ICT . CEMASTEA (2012). *Monitoring and Evaluation report*. Unpublished, Nairobi.

Government of Kenya (2010). *Progress on the implementation of flagship projects under the social pillar, Vision 2030*. Retrieved on 12th March 2013 from http://www.vision2030.go.ke/index.php/pillars/project/Social/143

Johnson, B., & Chritensen L. (2004). *Educational Research: Quantitative and Qualitative approaches*; Boston; Allyn & Bacon.

Ministry of information and communication (2006)- *National ICT policy:* retrieved on 6th April 2012 from http://www.information.go.ke/doc.ict20policy.pdf

Mugenda, O. M., & Mugenda, A. G. (1999). *Research methods: Quantitative and Qualitative Approaches*. Acts

Press, Nairobi.
Saunders, m., Lewis P., & Thornhill, A. (2007). *Research methods for business students. 4th edition:* Prentice Hall, England.
Sicilia, C. (2005). *The Challenges and Benefits to Teachers' Practices in Constructivist Learning Environments Supported by Technology*. Unpublished Master's Thesis, McGill University, Montreal.
Wakhaya, M. N. (2010). *Influence of the use of information and communication technology on teaching and learning of mathematics in secondary schools*; a case of Nairobi province, Kenya. Unpublished, Master's research thesis, University of Nairobi,
Yee, D. L. (2000). *Images of school principals' information and communication technology leadership.* Technology, Pedagogy and Education, 9(3), 287-302.