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Opportunities and Challenges: Integration of ICT in Teaching and Learning Mathematics in Secondary Schools, Nairobi, Kenya

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Abstract
This presentation is based on a larger study whose purpose was to explore the various opportunities and challenges influencing integration of ICT in teaching and learning Mathematics in secondary schools in Nairobi County. The study, adopted a descriptive survey design. Three instruments questionnaires', a structured interview schedule and an observation checklist were used to collect data. The study was carried out in twelve public secondary schools in Nairobi County. Data was analysed using descriptive statistics. Findings from the study indicated that, teachers face major challenges such as developing their own technological skills and knowledge as well as self-training in the use ICTs in their teaching. This lack of capacity building support was found by the study to contribute to teacher lax in integrating technology in their teaching inspite of the enthusiasm. This study recommends that new frontiers on technology integration be made accessible to both teachers and students for learning purpose to increase access to information and that, capacity building in technology integration be increased for teachers and awareness be built among pre-service teachers trainees integrating ICT in teaching and learning Mathematics.
Keywords: ICT, School and Teacher Challenges, Teaching and Learning Mathematics.

1. Introduction

In Kenya Mathematics is a compulsory subject in secondary schools. Due to its importance the government is committed in ensuring the provision of high quality Mathematics education. The government of Kenya through the Ministry of Education and Kenya Institute of Curriculum Development has come up with e-learning materials. Effectively introducing technology into schools is also largely dependent upon the availability and accessibility of ICT resources (e.g. hardware, software and communications infrastructure). Technology is essential in teaching and learning mathematics; it influences the Mathematics that is taught and enhances students' learning. There are several benefits of using ICT in teaching and learning Mathematics. ICT has the potential to transform the nature of education; improving teacher's design work, enhancing the roles of students and teachers in the learning process and helping to create a collaborative learning environment (Khan, Hossain, Hasan and Clement, 2012). However there are challenges and opportunities which hinder greatly the integration of ICT in teaching and learning Mathematics in secondary schools.

2. Opportunities and Challenges in Integration of ICT

The growth of information and communication technologies (ICT) has dramatically reshaped teaching and learning processes. Mathematics teachers are faced with inhibiting challenges or barriers to computer use (Hudson and Porter, 2010). For this reason, there have been several studies which have specifically focused on ICT integration in secondary Mathematics teaching. Drent and Meelissen (2008); Ottenbreit-Leftwich, Glazewski, Newby and Ertmer, (2010); Tsai and Chai (2012); and Wachira and Keengwe (2011) describe two types of barriers, currently hampering the integrated use of ICT by teachers:- external (first order) barriers and internal (second order) barriers.

Kipsoi, Chang'ach and Sang (2012) observe that policy makers in Kenya continue to introduce strategies for ICT, with the intention of increasing its use in secondary schools. These strategies are likely to have an effect on the school level factors. The teacher level obstacles are more difficult for policy makers to tackle as it is the teachers themselves who need to bring about the required changes in their own attitude and approach to ICT. Stigler and Hiebert (2009) in their research findings stated that, the main factor in front of Mathematics integration process is the gap between the curriculum's expectations and teachers' beliefs. However, Gao, Tan, Wang, Wong and Choy (2011) suggested that, the integration of ICT into the Mathematics classroom depends on individual teachers as well as the schools' contextual factors.

Teacher related, challenges impact on fundamental change and are typically rooted in teachers' core beliefs and are therefore the most significant and resistant to change. Fullan (2007). Teachers related factors refer to teacher comfortability, teacher confidence and teacher competence. Research indicates that lack of teachers' confidence prevents teachers from using ICT in their teaching (Peeraer and Van Petegem, 2011). Similarly Balanskat, Blamire and Kefala (2006) indicated that limitation in teachers ICT knowledge makes them feel anxious about using ICT in the classroom and thus not confident to use it in their teaching.

Teachers' computer competence is a major predictor of integrating ICT in teaching. Evidence suggests that majority of teachers who reported negative or neutral attitude towards the integration of ICT into teaching

and learning processes lacked knowledge and skills that would allow them to make an "informed decision" (Bordbar, 2010). A study conducted by Agyei and Voogt (2012) in Ghana among pre-service and in-service Mathematics teachers, reported low levels of ICT integration levels as a result of low competencies and access levels of ICT. Successful integration of ICT in teaching is related to teachers' competence and also their attitudes towards the use of modern technology in their teaching and learning Ayub, Bakar and Ismail (2012).

Positive attitudes towards computer use by school teachers are important to ensure the integration of the technology is effectively carried out in the school curriculum and also during teaching and learning (Buabeng-Andoh, 2012) . Teachers' attitudes are influenced by their perception of the usefulness of ICT, their behaviour intentions and pedagogical aspects (Ayub et al., 2012) . Teachers' attitudes towards using ICT in teaching and learning are also influenced by several factors.

In teaching and learning of Mathematics, teachers' beliefs about Mathematics learning with or without using technology are considered to be important because it could influence teaching and learning, and curriculum reform (Güven, Çakiroğlu and Akkan, 2009) . At the classroom level, teachers' beliefs can accelerate or slow down curriculum reforms as teachers' beliefs are resistant to change and play a role in teaching practices (Boaler, 2013). Findings from a study done in Kenya by (Kukali, 2013) has shown that teachers who begin using ICT in their teaching, initially believe that technologies creates more work for them. In addition,(Güven et al., 2009) found that, Turkish Mathematics teachers have negative beliefs about using computers in Mathematics teaching because of negative experiences; however, they expressed that these beliefs can be changed with in-service and out-of-service courses focusing on long-term constructivist approach.

School related challenges refer to inadequate provided resources such as infrastructure, support, trainings and time. In Kenya, teachers rated lack of time as one of the most problematic factor to technology utilization in schools. They further said that mastering technology requires time (Kukali, 2013). Breakdown of a computer causes interruptions and if there is lack of technical assistance, then it is likely that the regular repairs of the computer will not be carried out resulting in teachers not using computers in teaching. The effect is that teachers will be discouraged from using computers because of fear of equipment failure since no one would give them technical support in case there is technical problem (Buabeng-Andoh, 2012).

A study, in New Zealand and Australia conducted by Hudson and Porter (2010), found that, one of the barriers that Mathematics teachers identified in failing to adopt the use of computers in the classroom, is the lack of computer use is due to lack of experience in using computers in teaching Mathematics, lack of adequate professional training and lack of professional support in the use of computers in Mathematics instruction. Successful use of technology for the benefit of children depends on the knowledge of teachers and their confidence and competence in using technology. So not only do teachers need to learn how to use technology, they also need to learn how to apply the technology to teaching and learning. In addition, they need to know which technologies will most effectively meet children's skills, abilities and needs (Girgin, Kurt, and Odabasi, 2011).

3. Research Objective

The purpose of this study was to examine the challenges and opportunities to ICT use in teaching and learning Mathematics in secondary schools. Specifically, this research focused on school related and teacher related challenges and opportunities towards ICT in teaching and of learning Mathematics.

4. Methodology

This research used descriptive survey design and data collection was conducted on twenty four Mathematics teachers from twelve secondary schools in Nairobi County. Purposive sampling was used to select teachers from the twelve schools. For this purpose the researcher developed a questionnaire, an interview schedule and an observation check list that was piloted in a school was not included in the study. The instruments were validated by two educational lecturers. Reliability test was done using Cronbach alphaα. Cronbach's alpha coefficient was used to measure interval consistency of challenges and opportunities influencing integration of ICT in teaching and learning Mathematics. Data analysed was guided by the research objective. Data code sheets were created from those instruments then keyed into the statistical package for social science (SPSS) computer package. Qualitative data was grouped into similar themes in line with the research questions. Quantitative data was analysed using descriptive statistics like frequencies, mean and percentage.

5. Results of the findings

ICTs infrastructures, training and seminars are costly and financial plans are essential for secondary schools to catch up with rapid changes and improvement in hardware, software and networks. This study sought to find out the contributing opportunities and challenges which influenced integration of ICT in teaching and learning Mathematics from the respondents. The findings are presented in Table 1.1

Table 1.1: Opportunities and Challenges of ICT Use in Mathematics

	Responses % N=24			
Opportunities and Challenges in Integration of ICT in Teaching and Learning Mathematics	**S/A**	**A**	**D**	**S/D**
a) Mathematics teachers lack technical support regarding ICT integration.	17	41	17	25
b) There is inadequate time to integrate ICT in teaching Mathematics curriculum.	42	16	-	42
c) Schools are not interested in integrating ICT in Mathematics curriculum, because they lack competent and confident teachers.	08	09	42	41
d) Lack of training opportunities for ICT integration in teaching and learning Mathematics.	18	46	18	18
e) Mathematics teachers' lack of ICT skills and Knowledge.				
f) Mathematics teachers lack support from the school administration.	18	45	09	28
g) Mathematics teachers lack experience in using computers.	18	46	27	18
h) Inadequate ICT infrastructure for teaching and learning Mathematics.	09	46	27	18

Notably, two fifth of the respondents agreed that Mathematics teacher's lacked technical support in regards to ICT integration. Two fifth of the respondents strongly agreed that the current Mathematics curriculum does not allow enough time to integrate ICT in teaching. At least four ninth of the respondents strongly disagreed that schools are not interested in integrating ICT in the Mathematics curriculum, because they lack competent teachers and confident teachers. From the interview schedule two fifth of the Head of Department mentioned that teachers in their schools haven't fully embraced the use of ICT in teaching Mathematics due to limited resources and lack of confidence. Half of the respondent agreed that Mathematics teachers lacked training opportunity for ICT integration and knowledge acquisition in teaching and learning Mathematics. In addition, Mathematics teachers' lack of support from the school administration was agreed by half of the respondents. Lack of ICT skills and knowledge in Mathematics was agreed by half of the respondents. Finally two fifth of the respondents indicated that there was lack of adequate ICT infrastructure in teaching and learning Mathematics.

Similarly study revealed that at most a quarter of the students agreed that they had very large computer labs with very many functional computers that could cater for students needs in the school. Three quarters of the students indicated that there was inadequate ICT infrastructure in their schools, with reasons given for this including the following. The calculators that they were using didn't belong to the school, but there were own personal belongings. Computers were not enough and majority of the ones available were not in use due to technical problems causing them to use the functioning ones in shifts. Students had to overcrowded on one computer making learning difficult for them (it affected their concentration). They also lacked smart boards and projectors; and most of the computers were found not connected to the internet. Findings reveal that Mathematics teachers are not adequately prepared to handle ICT infrastructure's in Mathematics lessons.

5.1 ICT Facilities for Learning Mathematics

The effective use of ICT in teaching and learning Mathematics motivates both the learners and the teachers. This study sought to identify the conditions of ICT facilities for learning Mathematics in the schools as shown in Figure 1.1 below.

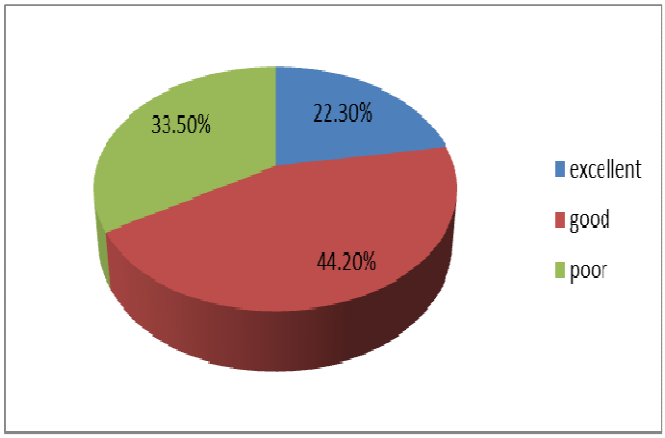

Figure 1.1: ICT Facilities for Learning Mathematics.

The study revealed that one fifth of the students considered that utility of ICT facilities in the school were excellent, while four ninth of the students indicated that the utility of ICT facilities was good. Finally a third of the students rated the use of ICT facilities in their school as poor. The study revealed that most secondary schools used ICT facilities during Mathematics lessons.

5.2 Effective Use of Mathematics software

Training enables teachers to acquire knowledge and skills on how to use Mathematics' software effectively. This study sought to find out from students whether their Mathematics teachers used Mathematics computer software effectively as shown in Figure 1.2 below.

Use of the Internet in Performing of Mathematics Task

Students have good general ICT skills, although they do not get the same advantage from using online resources. This study was interested in finding out if the use of internet contributes to their learning and performance of Mathematics task as shown in Figure 1.2 below.

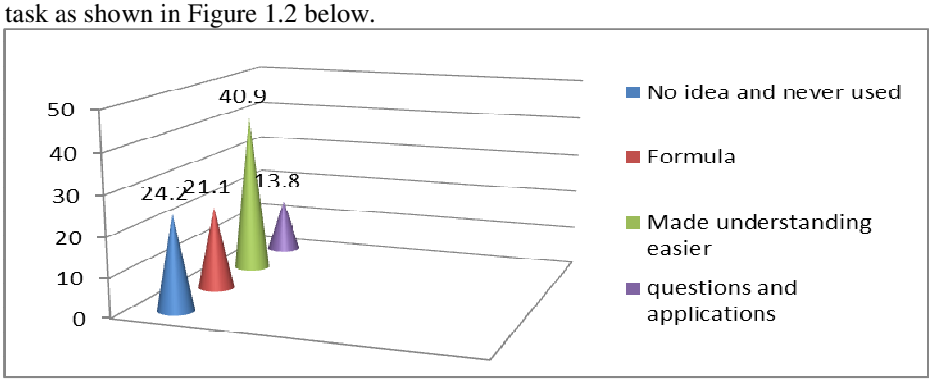

Figure 1.2: Use of Internet in Performing Mathematics Task.

Figure 1.2 indicates that nearly a quarter of the students did not have any idea because they never used the internet during Mathematics lesson this shows that that this students did not have access to the internet. One fifth mentioned that internet assisted them in getting formulae which they were not familiar with while two fifth mentioned that the internet made their understanding easier, while the use of internet to search for questions and application in Mathematics was mentioned by nearly one sixth of the students. The study reveals that most students have access to the internet during Mathematics lessons.

5.3 Challenges in Learning both Mathematics Content and Computer Technology

Difficulties in the use of ICTs and Mathematics software are related to the weakness of a teacher's knowledge about what technologies are available and how they can be used during learning Mathematics. This was to establish the challenges in learning both Mathematics content and computer technology, as shown in Figure 1.3 below.

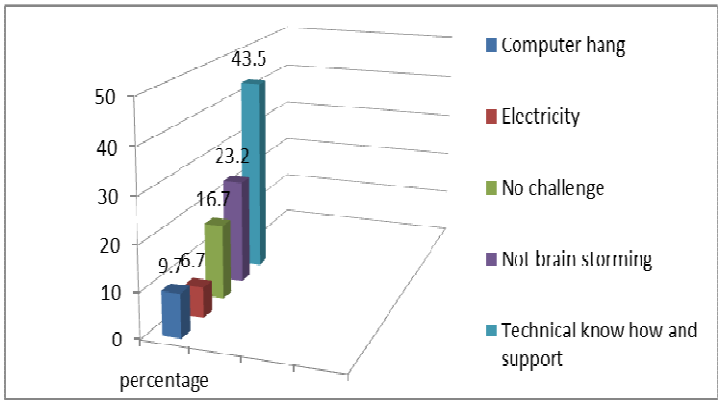

Figure 1.3: Challenges in using ICT in Learning Mathematics and Technology

The major challenge students experienced was lack of technical know-how and support while learning Mathematics with ICT, it was mentioned by four ninth of the students. This result indicates that students were willing to use ICT but lacked technical support from the teachers. Learning with ICT was not brain storming and that this affected their way of thinking and reasoning was mentioned by a quarter of the students, they further indicated that when using ICT in learning it only gave them one answer.

In addition, nearly one tenth indicated that most of the computers hang and this caused students to

overcrowd on one computer while, at least one twelfth indicated electricity was a challenge because it caused power surge, rendering computers useless and also inconvenienced their learning, one sixth mentioned that they experienced no challenge since they never used computers during Mathematics lessons. This shows that there are some students who cannot access computers at all or they cannot operate computers due to negative attitude towards ICT infrastructures.

Conclusions

The study found that were not adequately trained on ICT integration in teaching and learning Mathematics in secondary schools. The study concluded that teachers to be trained on how to use ICT infrastructure, on a regular basis and training to be done at zonal levels, at least after every six months. It also concluded that the government of Kenya to provide schools with ICT infrastructure to enable teachers to integrate ICT in their teaching and learning.

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