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The Influence of Technical Challenges on the Integration of ICT into the Teaching of Mathematics in Secondary Schools in Marakwet West Sub-County, Kenya

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Abstract:
ICT can be of great use in educational instruction. However, its usage in mathematics as a subject is still low. This can be attributed to a number of factors. The presence of computers and ICT tools in the school does not necessarily imply that they are successfully used in the teaching process. The purpose of the study was to investigate the challenges mathematics teachers encountered in the integration of ICT in teaching into mathematics instruction in secondary schools in Marakwet West Sub-County. Based on the study this study explores the technical challenges influencing the integration of ICT into teaching of mathematics in secondary schools. The study employed a descriptive survey design. A total of thirty-two principals and one hundred and four (104) mathematics teachers in Marakwet West Sub-County formed the target population of the study. A sample of 13 principals and 37 mathematics teachers were selected. Primary data was collected using questionnaires and interview schedules. The data collected was then analysed and presented using frequency tables and percentages. The research established that a number of technical challenges were experienced by mathematics teachers. Nonetheless, the prospect of integration of ICT into the teaching of mathematics is good. Based on the findings of the study, it is recommended that the government should make effort to closely monitor the policy implementations within schools.

Keywords: *Technical Challenges, Integration, ICT, Teaching, Mathematics, Secondary Schools, Marakwet, Kenya*

1. Introduction

Information communication technology (ICT) integration is the process of using any ICT (including information resources on the web, multimedia programs in CD-ROMs, learning objects, or other tools) in the delivery of instruction and assessment to enhance student learning. It is more of a process than a product. Much can be learnt from ICT practises from various countries, but the optimal level of integration of ICT in education cannot be determined from any one formula. Some of the challenges that policymakers and planners, educators, administrators and other stakeholders ought to consider include academic policy and planning, educational infrastructure, language, capacity-building and finance.

Magambo (2007) asserts that, at the Summit United Nations Millennium in September 2000, the global community adopted 8 Millennium Development Goals (MDGs) as part of the famous Millennium Declaration. These goals were set as targets to be met by the year 2015.In summary, MDGs aimed to eradicate hunger and extreme poverty, achieve free primary education, strengthen of equity based on gender, improve hygiene conditions, support environmental conservation and enhance overall development in poor countries. One of the issues specified in goal 8precisely refers to ensuring that the gains provided by new technologies (ICTs) are availed to all people (UNESCO, 2011).

Over the past few years much efforts and resources have been committed to enhancing teachers' competence and confidence in effective use of ICT in classroom teaching and learning (Magambo, 2007). Ministries of education develop policies on ICT in schools and running in service programmes for teachers. Teacher-training institutions have also incorporated ICT education in their training programmes. Many schools have organized in-house school based training for teachers, while globally many private providers are creating ICT training tools and courses for teachers.

Hennessey *et al.* (2010) argue that Africa and many other developing countries face numerous challenges in their attempts to integrate ICT into educational systems and processes. These challenges include lack of reliable accessibility to electricity, limited ICT infrastructure, especially internet access, bandwidth, software and hardware provision, instruction language and software; geo-factors, e.g. size of country, terrain, communication; demo-factors, e.g. population density and dispersion (Hennessey *et al.*, 2010). They

further identify educational factors such as levels of teachers' own education and levels of literacy, access to professional development, efficiency of learning resources, course curricula and other learning materials that incorporate ICT use.

1.1. Benefits of ICT Integration

The benefits of using ICT are numerous, ranging from benefits to classroom instruction in the school context to corporate world. In the education sector, ICT has engendered significant impact. Fisseha (2011) observes that ICTs are making major differences in the teaching approaches and the ways of learning of students. ICT-enabled learning environment facilitates active, collaborative, integrative, creative and evaluative learning. This is an advantage over the traditional method. This implies that ICT is becoming more appropriate in the achievement and implementation of the emergent pedagogy of constructivism which gives greater task of learning for students.

Fisseha (2011) still notes that using ICT in school produces ICT literate citizens. ICT define specific criteria and targets that help in the classification and categorization of the different development levels of using ICT in education. In a publication titled *The Value of Information and Communication Technologies (ICT) in Education* by Intel (2012) says the benefits of ICT usage in education is not only within the school but also to the community and entire country. Some of the community benefits of ICT include: its being a sound educational investment as it benefits both the teacher and the student and increases productivity; it leads to grater community involvement, and improved academic reporting. ICTs further support economic development, foster workforce development and increases global competition (Intel, 2012).

ICT offers users the opportunity to explore new things, provides a climate conducive for teaching-learning processes (Berhane, 2012).In addition, it offers teachers a flexible and effective ways of communicating, collaborating, processing and solving complex problems, all of which experiences contribute to cognitive development of teachers and learners. Berhane (2012) further states that the use of ICT broadens teacher horizons, study and teaching flexibility, elicits wide access of learning and student participation and sensible opportunity when and how to use ICT.

Fisseha (2011) highlights some of the benefits of ICT as follow: they offer the opportunity for more student-centred teaching; they provide greater opportunity for student-to-student and teacher-to-teacher communication and collaboration; they create greater enthusiasm for learning amongst students, and they provide teachers with new sources of information and knowledge. ICT integration also prepares learners for the real world and provides them with additional resources to assist resource-based learning. Regarding the policy goals, Fisseha (2011) reports that: ICT assist and facilitate learning to benefit of the learners and teachers across the curriculum; improve the efficiency of educational management and administration across all levels, from the classroom to the entire sector; widen access to quality educational services for learners at all levels of the education system. In the long-term, ICT produces people who are capable of working and taking part in the new economies and societies that are increasingly reliant on ICTs.

According to an Intel (2012) publication titled *The Value of Information and Communication Technologies (ICT) in Education*, ICT integration is beneficial to students as it enables personalised learning that is tailored to students' individual differences, level of progression, pace, interests, learning styles and background. Technology provides the support and essential challenge to keep students engaged and motivated besides empowering them to reach their potential. It enhances teamwork and cooperation to both learners and teachers. Lastly ICT enriches science, technology and mathematics learning an important grounding for future engineers, scientists, and technology experts (Intel, 2012).

As a benefit to the teacher, Berhane (2012) notes that integration of ICT into classroom instruction helps teachers to extend and explore their subject area, plan and prepare effective lessons, enhance their pedagogical expertise, adapt to the expansion of technology, increase their competence, skills and confidence, change their beliefs, make teaching fun, promote digital education, stimulate student learning, generate fast information flow, build a body of knowledge and computer experience.

1.2. Technical Challenges

Breakdown of computers causes interruptions and, in the absence of technical assistance, regular maintenance may not be carried out which further prevents teachers from integrating them in the teaching (Jones, 2014). This will discourage teachers from using computers and other ICT instruments due to fear of failure and breakdowns. BECTA (2006) argues that lack of technical support in a school increases the likelihood of technical maintenance not being carried out regularly hence a higher risk of breakdowns. In an assessment of the integration of technology in Turkish education, Yilmaz (2011) notes that apart from providing schools with hardware and internet connections, it is also crucial to provide them with technical support to assist in repair and maintenance as well as ensure the continued use of ICT in schools.

Consequently, without technical support, teachers may become frustrated, which contributes to their reluctance in the use of ICT (Tong &Triniada, 2005). In Britain and the Netherlands, Korte and Husing (2007) note that the support of ICT in schools influences teachers' use; teachers feel they do not need to waste time troubleshooting hardware and software problems. Without good technical support in the classroom, teachers cannot be expected to overcome the barriers hindering them from using the ICT resources available in school (Lewis, 2003).

According to Ratshitanga (2008), schools must employ someone to fix broken ICT equipment and provide other technical support services. This technical support covers installation, operations, network, maintenance, administration and security. Indeed, technical support is a crucial part of the implementation and integration of ICT in education systems; in the absence of a technical support person the school staff must be trained on troubleshooting skills needed to overcome the technical problems when using ICT (Ratshitanga, 2008).

Coffin and Hewings (2005) argue that technology initiatives can only be successful if they are compatible with the teaching conditions. They further note that the available technology must be reliable. Outdated computers often require regular repair and maintenance, which may cause frustration and reduce teachers' commitment to integrate ICT. Technical specialists provide recommendations for proper integration of technology into the curriculum and instructional activities. However, all teachers also need to understand how technology can be used as an instructional tool in all areas.

1.3. Statement of the Problem

Mathematics is one of the core subjects in secondary school curriculum in Kenya. As such, it is important to make the teaching of this subject appealing to learners. This is especially because, as Nkhwalume (2013) posits, mathematics is a problematic area for many learners and teachers. This does not mean that the teaching and learning of mathematics can never be an enjoyable experience. As noted by Chrysanthou (2008), ICT is an integral part of subject enjoyment in schools. Therefore, teachers should not deny students the exciting and challenging experiences in mathematics that ICT integration can engender.

Traditional forms of learning were not easy. They were based on a deficit model of learners where the process of transfer and reception of knowledge was individualized and facilitated by dissection of content into small chunks and a process that was linear. Nevertheless, the introduction of ICT is meant to change this complex traditional approach to education (Fathima, 2013). ICT makes learning neutral, active, social, linear or non-linear, contextualized and integrative based on the abilities and strength of learners (Fathima, 2013). ICT has the potential to transform the nature of education, that is, where and how learning takes place and the role of learners and the teacher in the learning process.

Following the above, it is essential that teachers have basic skills and competencies in ICT. The teacher has to determine how ICT can best be used in the entire instructional context: that is, culture, needs and the conditions of the school. Good ICT integration to teaching is not merely adding technology to the existing teaching and content domain. It should also result in representation of new concepts and development of greater sensitivity to the transactional dynamic relationship between the three components of knowledge, namely content, pedagogy and technology (Fathima, 2013).However, as stated earlier, the way ICT is used will depend on factors such as the subject being taught, the learning objectives and the nature of the students.

UNESCO (2011) posits that a number of issues may hinder schools and teachers in their efforts to integrate ICT in the learning institutions. These hindrances may include the inability to purchase the equipment, lack of access to the internet or appropriate materials. Underlying these challenges is the problem of whether or not teachers know how to effectively apply ICT in their teaching. According to UNESCO (2011), teachers need to use teaching methods that are in line with evolving knowledge societies. More so, students need to be assisted to acquire deep knowledge of their subjects in school besides understanding how they themselves can create new knowledge when using ICT as a tool.

To some teachers, the idea of using ICT is a novel and challenging one. Consequently, it may take time for teachers to fully understand how these new approaches to teaching are supposed to work. Strong leadership from the government is required and from those responsible for the education and professional training of teachers, the head teachers and school principals. Based on all the above issues, the study explored the challenges and prospects of ICT integration in mathematics instruction in secondary schools in Marakwet West Sub-County, Kenya, narrowing. Based on the study, this paper examines influence of technical challenges on the integration of ICT into the teaching of mathematics in secondary schools in Marakwet West Sub-County, Kenya.

2. Materials and Methods

The study was carried out in selected secondary schools in Marakwet West Sub-County, which is in Elgeyo Marakwet County. The study employed a descriptive survey design. Descriptive survey was used to gather data from the principals and mathematics teachers on the use of ICT in mathematics curriculum in secondary schools in the Sub-County. The study targeted all the principals of the 32 secondary schools and over 104 mathematics teachers in secondary schools in Marakwet West Sub-County. Mathematics teachers were key informants in the study because they are the major implementers of ICT integration into the teaching of mathematics in schools. On the other hand, principals were targeted because, being the administrators of schools, they supervise learning activities, coordinate the various departments and ensure that support facilities, including ICT, are provided in the school.

The sampling units for the study consisted of all secondary schools in Marakwet West Sub-County. Stratified sampling was used in the study to select the teachers. Two teachers from a single-streamed school, three from a double-streamed school and four from at least a triple-streamed school were selected. A sample of thirteen secondary schools was selected purposively from all the categories with some form of computers available in the schools. The principals of the selected schools were purposively selected.

The tools used to collect data were questionnaires, interview schedule and a checklist for the entry of returned questionnaires and interviews done. The collected data was checked for completeness, errors and any omissions. The data collected was then coded and entered into the computer for analysis. The data generated from the open-ended questions was organised into patterns, percentages and tabulation through content analysis. Since the analysis required the use of computer, the Spread Sheet was used. Quantitative data derived from the demographic section and other closed-ended questions was analysed using descriptive and referential statistics. Qualitative data generated from the open-ended questions was organized into themes and patterns, categorized through content analysis.

3. Results

The study sought to establish the technical challenges influencing the integration of ICT into the teaching of mathematics in secondary schools in Marakwet West Sub-County. To achieve this objective, the study assessed the availability of technical components of ICT.

3.1. Availability of Technical ICT Lab Assistants

Although most of the schools reported having computer laboratory, majority of them did not have a laboratory assistant in those laboratories. These results were as presented in Figure 1.

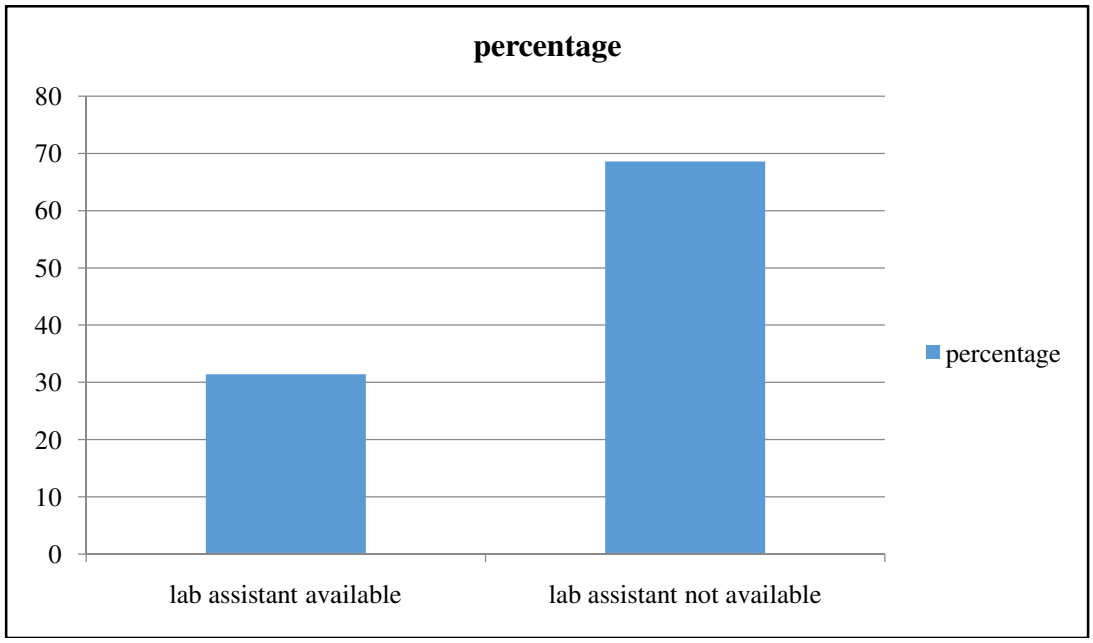

Figure 1: Availability of Laboratory Assistant

As show in Figure 1 above, 31.4% of the respondents affirmed the availability of a laboratory technician in their school while 68.6% responded otherwise. A laboratory technician helps in the maintenance of the laboratory and organisation of the necessary ICT tools in the lab prior to the lesson delivery. He/she also offers assistance to learners during and after lessons; in other words, the lab technician co-teaches the lessons with teacher. Therefore, as the study results showed, teachers of most schools lack the necessary technical support to use ICT in teaching.

3.2. Power Source Availability and Alternative Source of Power

The respondents were asked if the school was connected to the national grid for supply and if there was an existence an alternative source of power in school. All the respondents responded that the schools were connected to the national grid. Most of them affirmed that there was an alternative power source. The available alternative was either a solar panel or a generator. The Figure 2 below summarizes these findings.

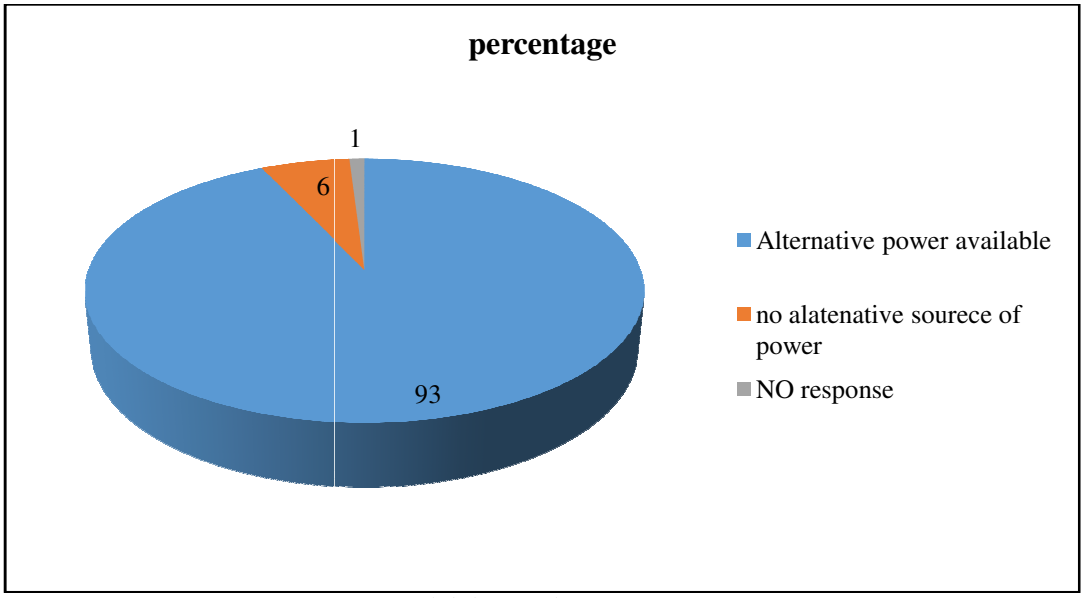

Figure 2: Availability of alternative power sources

From Figure 2 above, 93% of the respondents said the school had an alternative source of power, 6% said the school had no alternative source of power. Nearly 1% said the school did not have an alternative source of power. This implied that power supply challenge in schools was too minimal in the study area.

3.3. Availability of Repair Services

The research sought to establish if repair services for the ICT tools were promptly available. The study found that finding repair services were a challenge to most schools. The results were as shown in Figure 3 below.

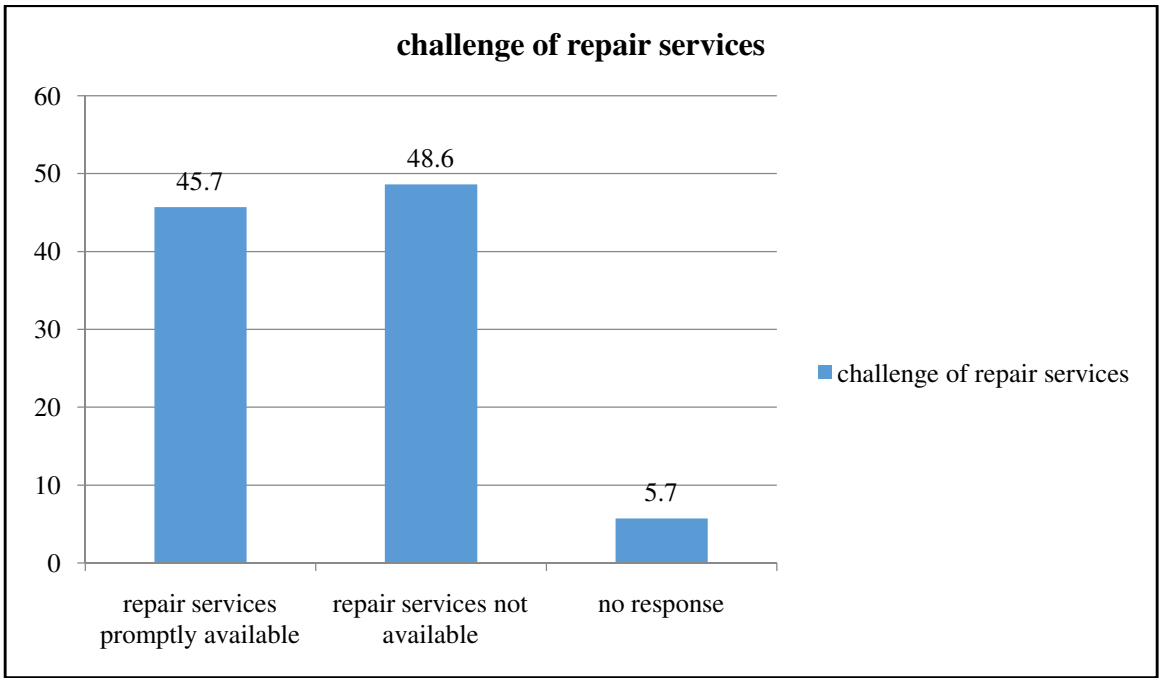

Figure 3: Availability of repair services

From the results in the figure above, it is clear that repair services are not promptly available to most schools. Of the schools, 48.6% of the teachers indicated the absence of such services while only 45.7% responded that the services were available. On this, 5.7% gave no response. This implied that repair services were lacking in most schools. The absence of repair services implies that in case of breakdowns of ICT tools, most lessons are put on hold.

3.4. Computer Connectivity

Mathematics teachers were further asked to state whether or not computer connectivity to available internet and other networks had been put in place in their schools. The results on this issue were as shown in Figure 4 below.

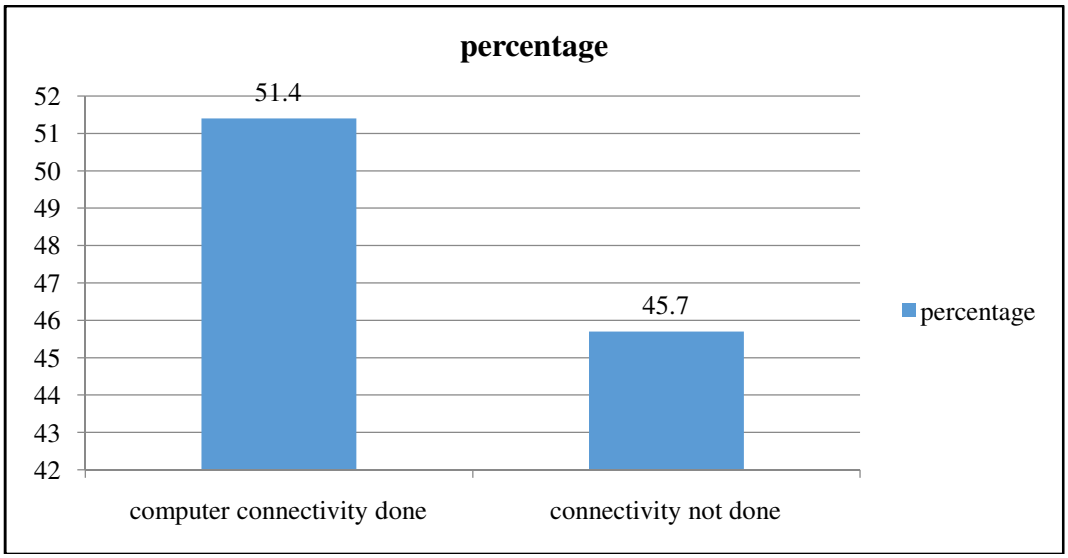

Figure 4: Computer connectivity and internet accessibility

From the findings in Figure 4 it can be seen that 45.7% of the respondents indicated that computer connectivity had not been done in the school against 51.4%. The study found that computer connectivity had not been availed in most schools. This remained a challenge in the integration of ICT into the teaching of mathematics. Successful use of computers in teaching of mathematics requires one on one interaction with the students in a classroom.

However, most of the computers in the schools had the capacity to access the internet. This was possible despite the fact that in a number of schools' wireless fidelity had not been enabled. These results were as presented in Figure 5 below.

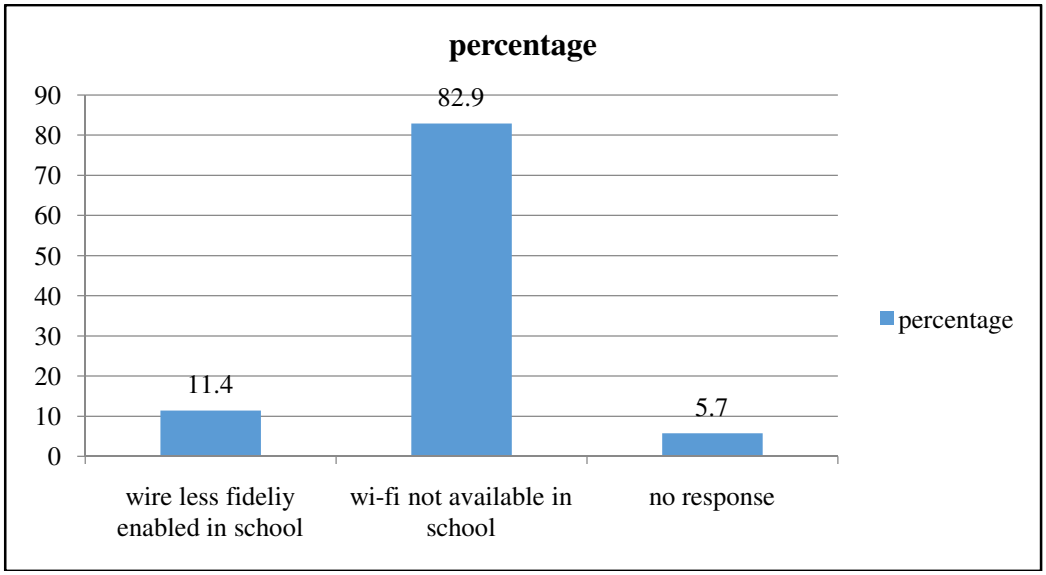

Figure 5: Wire-less connectivity in school

From Figure 5 above, it is clear that there was no Wi-Fi in most schools. This was indicated by 82.9% of the respondents. It is an important component in internet accessibility. Accessibility is quite important in order to tap into the variety of teaching resources in various varied sites.

3.5. Level of Integration of ICT into the Teaching of Mathematics

Mathematics teachers were asked to comment on the degree of use of ICT in the teaching of mathematics in their schools. The results obtained from their comments were as presented in the table below.

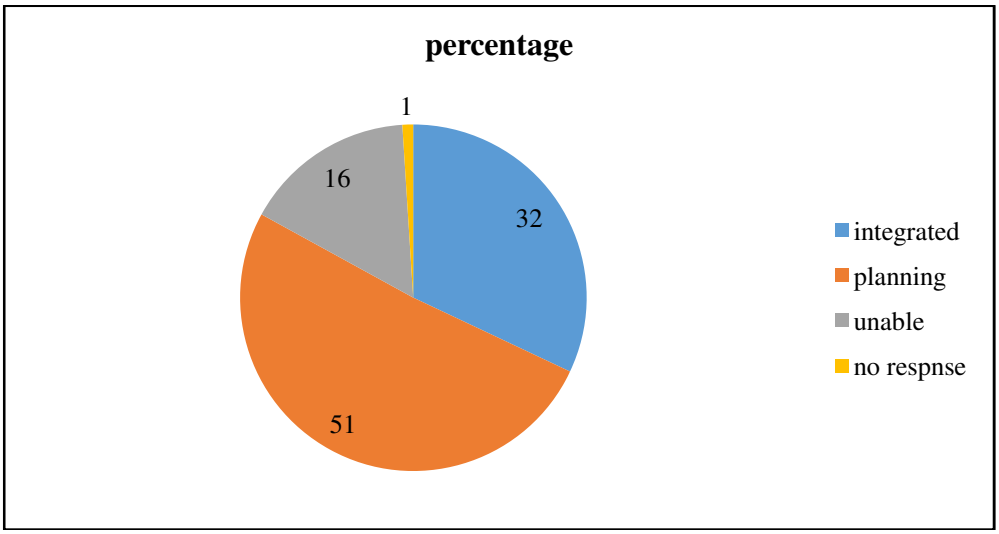

Figure 6: Degree of integration of ICT in teaching mathematics

From Figure 6 above, 51% of the teachers were still planning to integrate ICT into the teaching of mathematics, 32% had integrated, 16% were unable to integrate and 1% of the respondents gave no response. It became evident that most of the mathematics teachers were yet to integrate ICT into their teaching.

3.6. Other Technical Challenges

Mathematics teachers were asked to list other technical challenges besides the ones mentioned above. One challenge they noted was that most of the mathematics material and resources available exist in print form. One principal affirmed that there was no digital mathematics content. Therefore, the use of ICT in teaching mathematics was a challenge to his school. Another challenge noted was the lack of white boards to facilitate teaching and learning. Breakdowns of power generator in schools and blackouts was also identified as another challenge. Other challenges included poor connectivity and interconnectivity, and lack of appropriate software applicable to mathematics instruction.

4. Discussion

The study established that a number of technical challenges influenced the integration of ICT into the teaching of mathematics in secondary schools in Marakwet West Sub-County. All the schools were connected to the national grid for electrical power supply. Most of them also had an alternative source of power. However, constant breakdowns of power connectivity and back-up generators left many schools in blackouts. In a study on the skill-elated challenges facing the adoption and use of ICT in public secondary schools in Meru County, Kenya, Laaria (2013) has reported the challenge of limited and unreliable supply of electricity as the greatest(identified by 64.55%). Laaria (2013) attributes this to minimal intervention on power connectivity by the Kenya government.

Most of the schools had a computer laboratory, but the main challenge for most schools was lack of a laboratory assistant. Of the respondents, 68.6% said that there was no laboratory assistant in their school. Such technical assistants help mathematics teachers to use of ICT. They help teachers to prepare and offer support during actual lesson delivery. Some schools reported that the laboratories they had were too small in size to support the number of students ina single class. Quite a number had fitted the laboratories with requisite chairs and seats but still laboratory furniture remained a challenge for most schools. The problem of lack of technical support has been greatly reported in a study by Laaria (2013).

Repair services for the ICT tools were reported missing by many (48.6%) schools. Prompt repair services are essential in ICT use and other machines in general. The absence of such services implies that most schools forego ICT applications whenever they experienced unexpected breakdowns. Another possible alternative is postponing the lesson when such breakdowns occur, which ultimately leads to a lag in syllabus coverage. Most schools reported poor computer connectivity. This finding resonates with those of Jones (2014) who says that breakdowns interrupt and without the necessary technical assistance and regular repairs teachers may become discouraged.

Connectivity of computers is an important aspect of computer applications. In the absence of connectivity extra human resource may be required for effective teaching and learning using computers. Most of the computers in the studied schools could not access the internet. Moreover, WI-FI connectivity had not been configured in most schools. The internet is a haven of information and other learning resources. It helps teachers and students to generate notes, illustrations and the necessary animations for effective learning. Most of the teachers were still yet to integrate ICT in mathematics. A few of them said they were completely unable to integrate ICT into mathematics instruction. These findings reiterate those of Laaria (2013) that ICT has been adapted to some extent.

5. Conclusion and Recommendations

Schools in Marakwet West Sub-County experience a number of technical challenges in their attempt to integrate ICT into the teaching of mathematics. Some of these challenges include lack of laboratory technicians into computer laboratories in school, lack of repairs services, computer connectivity and networking. Other challenges include poor access to the internet, absence of digital mathematics contents in school libraries, network related challenges and lack of appropriate software for teaching mathematics. These technical challenges have contributed to low adoption of ICT into the teaching of mathematics.

Based on the findings of the study, it is recommended that the government should make effort to closely monitor the policy implementations within schools. It should also work with schools to provide solutions to the challenges faced by schools. There is also a need to equip schools with the necessary ICT tools and ensure they are networked to properly support teaching and learning activities.

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