Journal of Education and Practices (JEPs)
Vol 1. Issue No. 1. August, 2018. PP 35-43. ISSN 2617-5444

READINESS OF PUBLIC SECONDARY SCHOOLS TO INTEGRATE ICT IN MATHEMATICS TEACHING IN MOGOTIO SUB-COUNTY OF BARINGO COUNTY, KENYA

[1]John Kirkok & [2]Daniel Karanja

[1]School of Education, Kenyatta University, Kenya
[2]Faculty of Education & Community Studies, Egerton University, Kenya
Received: July 25, 2018
Accepted: July 26, 2018
Published: August 13, 2018

Abstract

This study investigated the availability of ICT infrastructure like computer laboratories, computer hardware and software programs for integrating ICTs in Mathematics teaching in public secondary schools in Mogotio Sub-County of Baringo County in Kenya. It employed a descriptive survey design. Head teachers and Mathematics teachers of public secondary schools in the district were targeted. Systematic sampling technique was used to select 10 (45.45%) schools from a list of 22 public secondary schools obtained from Mogotio District Education Office. From the 10 sampled schools, all the 10 (45.45%) head teachers and all the 24 (60%) Mathematics teachers were purposively sampled to participate in the study. Questionnaires and an observation schedule were used to collect data. Descriptive statistics such as frequencies and percentages were used to analyze the data quantitatively. The findings revealed that public secondary schools were inadequately equipped with ICT facilities and equipment. In addition, most of the schools lacked software, application programmes and digital content necessary for integration of ICTs in Mathematics.

Keywords: ICT, Integration, Mathematics Teaching, Readiness

I.Introduction

The use of Information Communication Technologies (ICTs) in the Mathematics classroom has long been a topic for consideration by Mathematics educators. In recent years, it has increasingly become evident that the use of ICTs together with skilful scaffolding by the teacher enhances the learning of Science and Mathematics and any other areas that are generally abstract or have a high cognitive demand for the students (Cox, et al, 2001). According Polonoli (2001) and Goddard (2002) public perception also has it that ICTs like the computer represents both an excellent curricula tool and revolutionary classroom approach that can help students to realize important gains in learning and understanding of mathematical concepts. It is thus viewed as a powerful and realistic tool for the classroom and as having the potential of making teachers' work easier and more efficient (Pelgrum, 2001; Kozma and Anderson, 2002).

Ittigson and Zewe (2003) posit that ICT supports constructivist pedagogy, wherein students use technology to explore and reach an understanding of mathematical concepts. This approach promotes higher order thinking and better problem solving strategies. Students can therefore use technology to concentrate on problem-solving processes rather than on calculations related to the problems. Becta (2003) also lists out some key benefits of ICT as: It promotes greater collaboration among students and encourages communication and the sharing of knowledge; ICT gives rapid and accurate feedbacks to students and this contributes towards positive motivation; It allows students to focus on strategies and interpretations of answers rather than spend time on tedious computational calculations.

Some examples of ICT use in Mathematics include: portables, graphic calculators and computerized graphing, specialized software, programmable toys or floor robots, spreadsheets and databases. A range of portable devices exists which allow pupils to collect data, and manipulate it using spreadsheets and databases for work in numeracy. Some of these portable equipment also enable the study of Mathematics to move out of the classroom and to incorporate fieldwork investigations (Moseley and Higgins, 1999). The use of graphic calculators and computerized graphing in Mathematics speeds up the graphing process, freeing people to analyze and reflect on the relationships between data (Hennessy, Fung & Scanlon, 2001).

Specialized software such as Computer Algebra Systems (CAS), Dynamic Geometry Systems (DGS) and Mathematics curriculum software improve pupils' skills and understanding in algebra, allows pupils to manipulate and measure shapes leading to higher level of learning among them (Hennessy, et al. 2001; Clements, 2000). Programmable toys or floor robots controlled by instructions in programming languages (usually logo) were one of the earliest applications of ICT to mathematics, and where used were the cause of significant changes in mathematics teaching (Becta, 2003). Logo encourages pupils to develop problem-solving skills, leads them to develop higher levels of mathematical thinking as well as learn geometric concepts (Clements, 2000).

The problem of effective ICT integration into the teaching of Mathematics is a complex innovation for teachers. They do not only need to have competent knowledge of teaching Mathematics but also need to be competent in the pedagogical use of ICTs in addition to having access to appropriate ICT tools (Voogt, 2008). Many studies have shown several obstacles that teachers experience in the integration of ICT in their classrooms. Jones (2004) found a number of barriers for the integration of ICT into lessons and listed them as: Lack of confidence among teachers during integration; lack of access to resources; lack of time for the integration; lack of effective training; facing technical problems while the software is in use; lack of personal access during lesson preparation; and the age of the teachers.

Snoeyink and Ertmer (2002) also identified other barriers to the integration of ICTs into Mathematics lesson as lack of computers, lack of quality software, teacher attitudes towards computers, poor funding, resistance to change, poor administrative support, lack of computer skill, poor fit with curriculum, scheduling difficulties, poor training opportunities, and lack of vision as to how to integrate ICT in instruction. It is evident that all these barriers relates to ICT infrastructure, teachers skills to integrate the ICTs in subject teaching and teachers attitude towards ICT use in instruction. This study seeks to assess how public secondary schools in Mogotio District are prepared as regards to integrate ICTs in the teaching of Mathematics.

Mathematics in Kenya is a core subject and a critical filter for career choices. However, student performance in the Kenya Certificate of Secondary Education examination (K.C.S.E) has been dismal over the years. According to Mogotio District Kenya National Examination Council (KNEC) Mathematics analysis as depicted in figure 1.1, the formidable problem currently facing Mathematics education in Kenya is therefore the need to improve the students' performance in Mathematics.

According to Strengthening of Mathematics and Science in Secondary School Education (SMASSE) Report of 2008, the poor results have been attributed to various causes ranging

from lack of learning materials and poor teaching methods to psychological factors like poor attitude towards the subject. To redress these causes, the Ministry of Education and other stakeholders have embarked on various large-scale capacity building seminars and workshops that are aimed at strengthening the teaching of Mathematics and the Sciences in Kenyan secondary schools. In 1998, SMASSE was piloted in nine of the former 65 Districts.

In 2003, the programme was implemented nationwide with the hope of solving pedagogical issues that have contributed to poor performance in Mathematics and science subjects over the years. The government has also allocated grants to public secondary schools for the purchase of basic resources like textbooks. The Ministry of Education (MoE) also introduced the use of scientific calculators for instruction and examination of candidates at KCSE aimed at enhancing performance in the subject (MoE, 2005).The SMASSE has also been in the forefront in advocating for the integration of ICTs in the teaching of Mathematics and sciences in secondary schools in the country. All these initiatives are expected to yield outstanding results in the subject in terms of solving perennial problems inherent in the subject.

As pertains to policy and efforts to leverage use of ICTs in education, Kenya drafted an ICT policy in January 2006. Some of the strategies proposed in the growth and implementation of ICT in education are that the government will:

i. Promote the development, sharing and integration of E-learning resources to address the educational needs of primary, secondary and tertiary institutions.

ii. Enhance the dissemination of E-learning initiatives through provision of affordable infrastructure (Republic of Kenya, 2006a).

The ICTs in Education Options paper for the Ministry of Education, Science and Technology (MOEST) discusses the ways in which ICTs can be leveraged to support and improve the delivery of quality education for all Kenyans (Republic of Kenya, 2006a). The ideas presented here respond to the educational priorities outlined in Sessional paper No. 1 of 2005 and the Kenya Education Sector Support Program (KESSP). The KESSP provides a roadmap for investment in E-learning and suggests provisional budgets to support educational activities. E-learning is identified in the following investment programs:

i. Primary Teacher In-service Training: This program aims at in-servicing teacher trainers on E-learning methodologies so that teachers can be equipped with the skills on how to integrate ICT in education.

ii. ICT in Education Investment Program: This program outlines the strategies and policies that will foster E-learning delivery systems, build the necessary capacity and promote the development of required ICT infrastructure and institutional management systems (Republic of Kenya, 2005b).

The Ministry of Education in collaboration with the private sector through the Kenya ICT Trust Fund developed a National ICT Strategy for Education and Training aimed at making ICT integration possible at all levels of education and training. The strategy outlines how Information and Communication Technology will be adopted and utilized to improve access, quality and equity in the delivery of education services in Kenya. It identifies the strategic

pillars for sector ICT implementation as: establishment of a policy framework; digital equipments; connectivity and network infrastructure; technical support; harnessing emerging technologies; digital content development; integration of ICTs in education; training (capacity building including professional development); research and development; partnership and resource mobilization; legal and regulatory framework and monitoring and evaluation (Republic of Kenya, 2006b).

Other efforts include equipping of over 450 secondary schools with computers and provision of Ksh. 213 million by the government to 142 secondary schools to purchase computers. Education and Energy ministries in conjunction with the government of Finland have also embarked on a program to supply rural public secondary schools with power and internet connection (International Conference on ICT Development, Education and Training E-learning in Africa, 2007).

E-content is also now available and a curriculum innovation centre was launched at K.I.E in March, 2010 for purposes of enhancing curriculum delivery (ICWE, 2010). All these reflect the seriousness with which the government treats inclusion of ICT in classroom instruction. According to Kenya ICT 4E situational analysis (2009), the following achievements have also been realized: Ministry of education (MOE) has disbursed Ksh1.5 million to 213 schools evenly distributed across the country to be used to acquire 25 new computers per school, 1 printer per school, educational software and sensitize ICT teachers on technical maintenance. Computers for Schools Kenya (CFSK) reported to have installed 18,000 computers in over 600 schools with 20 computers per school.

The ICT Trust Fund has provided 200 schools with 20 computers each. The NEPAD e-schools project provided 6 schools with 20 computers each. The Rural School Project has provided 4,500 computers to a number of unidentified schools. Overall, the analysis indicated that 15,450 computers have been disbursed to 1,300 secondary schools out of over 4,000 schools. The government has also made effort to engage the private sector in the provision of laptops with the ICT integration team providing specifications and ensuring quality of laptops with the wider ICT integration agenda. Loans have also been availed by Teachers service commission (T.S.C) to teachers for laptop acquisition and subsequently recovered through check off systems. The purpose is to encourage teachers to use modern and dynamic educational tools (Kenya ICT 4E Situational Analysis, 2009).

Despite the aforementioned initiatives and efforts to leverage use of ICTs in public secondary schools in Kenya and the fact that research has clearly shown that ICTs increase access to instructional materials and provides several other benefits that can enhance the teaching and performance of Mathematics, there is a dearth in literature on the status of readiness to integrate ICTs in mathematics teaching in the Mogotio Sub-County. This necessitated the conception of this study.

II.Objective of the Study

To assess the availability of ICT infrastructure (like computer laboratories, computer hardware and software programs) for integrating ICTs in Mathematic teaching in the schools.

III.Literature Review

Integration of ICTs in Teaching and Learning

The field of education has been affected by ICTs, which have undoubtedly affected teaching and learning. Yusuf (2005) observes that ICTs have the potential to accelerate, enrich, and deepen skills, to motivate and engage students, to help relate school experience to work practices, create economic viability for tomorrow's workers, as well as strengthening teaching and helping schools change.

Conventional teaching has emphasized content. For many years, courses have been written around textbooks. Teachers have taught through lectures and presentations interspersed with tutorials and learning activities designed to consolidate and rehearse the content. Contemporary settings are now favoring curricula that promote competency and performance. Curricula are starting to emphasize capabilities and to be concerned more with how the information will be used than with what the information is. Contemporary ICTs are able to provide strong support for all these requirements and there are now many outstanding examples of world class settings for competency and performance-based curricula that make sound use of the affordances of these technologies (Oliver, 2000). The integration of information and communication technologies can help revitalize teachers and students. This can help to improve and develop the quality of education by providing curricular support in difficult subject areas.

According to Oliver the flexibility time-space accounted for by the integration of ICT into teaching and learning processes contributes to increase the interaction and reception of information. Such possibilities suggest changes in the communication models and the teaching and learning methods used by teachers, giving way to new scenarios which favor both individual and collaborative learning. The ICTs by their very nature are tools that encourage and support independent learning. Students using ICTs for learning purposes become immersed in the process of learning and as more and more students use computers as information sources and cognitive tools (Reeves & Jonassen, 1996), the influence of the technology on supporting how students learn will continue to increase.

In the past, the conventional process of teaching has revolved around teachers planning and leading students through a series of instructional sequences to achieve a desired learning outcome. Typically these forms of teaching have revolved around the planned transmission of a body of knowledge followed by some forms of interaction with the content as a means to consolidate the knowledge acquisition. Contemporary learning theory is based on the notion that learning is an active process of constructing knowledge rather than acquiring knowledge and that instruction is the process by which this knowledge construction is supported rather than a process of knowledge transmission (Duffy & Cunningham, 1996). In this domain learning is viewed as the construction of meaning rather than as the memorization of facts (Jonassen & Reeves, 1996). Learning approaches using contemporary ICTs provide many opportunities for constructivist learning through their provision and support for resource-based, student centered settings and by enabling learning to be related to context and to practice (Barron, 1998).

Elina (2008) observes that in a study carried out in Romania between August 2007 and May 2008, to investigate ICT use in education, 7 out of 10 teachers preferred to teach using computers. The teachers linked good performance in their disciplines to use of ICT. This

study indicated that students considered the most important effect of using ICT for school lessons as a simplified learning process followed by easier understanding of content.

Integration of ICTs in Mathematics Teaching and Learning

Ittigson and Zewe (2003) observed that technology is essential in teaching and learning Mathematics. The two note that ICT improves the way Mathematics should be taught and enhances student understanding of basic concepts. Becta (2003) summarized the key benefits of integrating ICTs in Mathematics teaching as: ICT promotes greater collaboration among students and encourages communication and the sharing of knowledge; it gives rapid and accurate feedbacks to students and this contributes towards positive motivation; it allows them to focus on strategies and interpretations of answers rather than spend time on tedious computational calculations and it also supports constructivist pedagogy, wherein students use technology to explore and reach an understanding of mathematical concepts. This approach promotes higher order thinking and better problem solving strategies which are key in learning Mathematics.

According to Keong, Horani and Daniel (2005) for a successful integration of ICT into the Mathematics curriculum, it is essential to have knowledge of the existing software that is used by Mathematics teachers. A survey carried out by Forgasz and Prince (2002) found that 61% of the respondents (teachers) used spreadsheets, 45% used word processing and 30% used Internet browsers. In the same survey, it was found that 19% used Geometer's sketchpads, 19% used CD-ROMs that accompanied Mathematics textbooks, 18% used Graphmatica, 14% used Maths Blaster and 8% used other mathematics-specific software. Keong et al, however, notes that knowledge of the use of software on the part of the teachers is not the only criterion for integrating ICT into Mathematics lessons. The authors observe that a sound pedagogical knowledge on how to integrate it is another critical success factor.

Amarasinghe and Lambdin (2000) described three different varieties of technology usage: Using technology as a data analysis tool; using technology as a problem-solving/mathematical modeling tool; and using technology to integrate Mathematics with a context. Meanwhile Balacheff and Kaput (1996) have discussed the impact of technological forces on learning and teaching Mathematics. These researchers argued that with the introduction of technology, it is possible to de-emphasize algorithmic skills; the resulting void may be filled by an increased emphasis on the development of mathematical concepts.

Technology saves time and gives students access to powerful new ways to explore concepts at a depth that has not been possible in the past. The power of computers leads to fundamental changes in Mathematics instruction. For example, the ability to build and run complex mathematical models, and easy exploration of "what if" questions through parametric variation has opened up new avenues for Mathematics (Dreyfus, 1991). Furthermore, as Munirah (1996) observes, the teaching of calculus has seen a dramatic change now that activities such as exploring Mata or graphical data analysis have been revolutionized by the computer technology. It is also reported that weaker students often are better able to succeed with the help of technology, and thereby come to recognize that Mathematics is not just for their more able classmates (Wimbish, 1992).

IV.Research Methodology

The study employed a descriptive survey design. Head teachers and Mathematics teachers of public secondary schools in the district were targeted. Systematic sampling technique was used to select 10 (45.45%) schools from a list of 22 public secondary schools obtained from

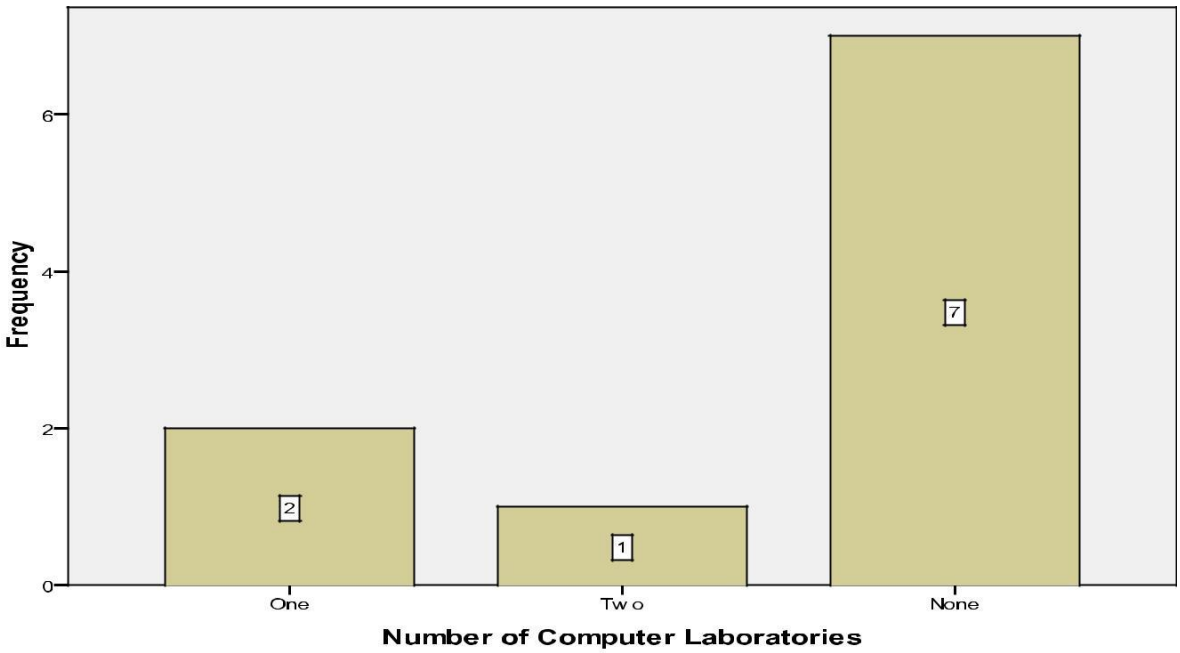
Mogotio District Education Office. From the 10 sampled schools, all the 10 (45.45%) head teachers and all the 24 (60%) Mathematics teachers were purposively sampled to participate in the study. Questionnaires and an observation schedule were used to collect data. After coding the responses, data was entered into the Statistical Package for Social Sciences (SPSS) computer program. Descriptive statistics such as frequencies and percentages were used to analyze the data quantitatively. Qualitative data obtained from the open-ended questions was analyzed according to themes based on the study objectives. Analyzed data was presented using tables and charts.

V.Research Findings

Infrastructure for Integrating ICTs in Mathematics Teaching

Data obtained from the 10 sampled secondary schools revealed that seven (70%) of the schools had no computer laboratory two (20%) had one computer laboratory each while one (10%) had two computer laboratories as shown in Figure 1 below.

Figure 1: Number of Computer Laboratories in Secondary Schools



The data also revealed that nine of the head teachers (90%) stated that the ratio of personal computers against the teachers and students population was inadequate in their schools. This is detrimental for effective integration of ICTs in Mathematics teaching because computers are the main platform where other integration tools like mathematical software and Internet run.

In terms of software, application programmes and digital content for Mathematics teaching, the findings revealed that the secondary schools were ill equipped with only one (10%) of the schools affirming that they had acquired software suited for Mathematics teaching while nine of them (90%) did not have any of the afore said resources. No school was found to allocate funds for integrating ICTs in Mathematics teaching and learning.

These findings are in agreement with Farrell (2007) who from a survey of ICT and education in Kenya noted that very few secondary schools had sufficient ICT tools for teachers and students and even in schools that had computers, the student-computer ratio was very high to enhance any meaningful ICT integration in teaching. In addition, a study by Wabuyele (2003) indicated that while ICT has penetrated many sectors including banking, transportation, communications, and medical services, the Kenyan educational system seems to lag behind. The study found that computer use in Kenyan classrooms is still in its early phases, and concluded that the perceptions and experiences of teachers and administrators do play an important role in the use of computers in Kenyan classrooms. Kenya School Net (2003) also found out that although schools were aware of benefits of ICTs in teaching, only a few had adequate ICT tools like computers and Internet that are essential for effective ICTs integration in teaching.

VI. Conclusion

Public secondary schools in Mogotio Sub-County of Baringo County were inadequately equipped with facilities like computer laboratories and equipment like computers required for the successful integration of ICTs in mathematics teaching implementation. In addition, most of the schools lacked software, application programmes and digital content necessary for integration of ICTs in Mathematics teaching.

VII. Recommendations

Education stakeholders in Mogotio Sub-County should finance provision of ICT facilities and digital equipment in public secondary schools. This will enhance access to ICT facilities by students and teachers, improve the current teachers and student computer ratio and enable hands-on experiences with these resources during Mathematics teaching and learning. In addition, MoE should provide standardized mathematical software, application programmes and digital content to all schools to enable them implement effective ICTs integration in Mathematics teaching with ease.

References

1) AACTE Committee on Innovation & Technology (Ed.). (2008). *Handbook of Technological Pedagogical Content Knowledge (TPCK) for Educators*. New York and London: Taylor and Francis Group.
2) Adamy, P., & Boulmetis, J. (2006). The impact of modeling technology integration on pre-service teachers' technology confidence. *Journal of Computing in Higher Education,* 17(2), 100–120.
3) Amarasinghe, R. and Lambdin, D. (2007). *Uses of Computer Technology in Interdisciplinary Mathematics Learning.* International Conference on Learning with Technology; Temple University, Philadelphia, PA. CD. v. 185
4) Bagozzi, R. P., Davis, F. D., & Warshaw, P. R. (1992). Development and Test of a Theory of Technological Learning and Usage. *Human Relations*, 45(7), 660-686.
5) Balacheff, N., & Kaput, J.J. (1996). *Computer-based learning environments in mathematics*. In A.J. Bishop et. al. (Eds.), International handbook of mathematics education, (pp.469- 501). New York: Macmillan.
6) Brown, D., and Warschauer, M. (2006). From the university to the elementary classroom: students' experiences in learning to integrate technology in instruction. *Journal of Technology and Teacher Education,* 14(3), 599–621.
7) Clements, D. H. (2000). From exercise and tasks to problems and projects- unique contributions of computers to innovative mathematics education. *The Journal of Mathematics Behavior*, 19(1), 9–47.
8) Dreyfus, T. (1991). On the status of Visual reasoning in mathematics and mathematics education. In F. Furinghetti (Ed.), *Proceedings of the 15th international conference for the psychology of mathematics education* (Vol. 1, pp.33-48). Genoa: University of Genoa.

9) D'Sousa, Sabita, M. and Woods, L. (2003). *Secondary Students' Resistance Toward Incorporating Computer Technology into Mathematics Learning. Mathematics and Computer Education*, Retrieved from http://www.findarticles.com. On 23rd august, 2012.
10) Duffy, T., & Cunningham, D. (1996). Constructivism: Implications for the design and delivery of instruction, *Handbook of research for educational telecommunications and technology* (Pp. 170-198). New York: MacMillan.
11) Forgasz, H.J. and Prince, N. (2002). Software used for mathematics learning – reporting on a survey. *Vinculum*, 39(1), 18-19.
12) Kynigos, C and Argyris, M. (2004). Teacher beliefs and practices formed during an innovation with computer-based exploratory mathematics in the classroom. *Teachers and Teaching: theory and practice*, Vol. 10, No. 3, 247-273, June 2004.
13) Manoucherhri, A. (1999). Computers and School Mathematics Reform: Implications for Mathematics Teachers Education. *Journal of Computers in Mathematics a Science Teaching*, 18(1), 31-48.
14) Moseley, D., & Higgins, S. (1999). *Ways forward with ICT: Effective pedagogy using information and communications technology for literacy and numeracy in primary schools*. London: Teacher Training Agency.
15) Schoenfeld, A. (1987). *Cognitive Science and Mathematics Education*. New Jersey: Laurence Erlbaum Associates, Inc. Publishers.
16) Snoeyink, R., & Ertmer, P. A. (2002). Thrust into technology: how veteran teachers respond. *Journal of Educational Technology Systems*, 30(10), 85–111.
17) Swan, B. & Dixon, J. (2006). The Effects of Mentor-Supported Technology Professional Development on Middle School Mathematics Teachers' Attitudes and Practice. *Contemporary Issues in Technology and Teacher Education* [Online serial] 6(1). http://www.citejournal.org/vol 6/. United States Department of Education, National centre for Education (1996). *Survey on advanced telecommunication in US public schools*, Fall 1996 FRSS 61.
18) Voogt, J. (2008). *IT and curriculum processes: Dilemmas and challenges*. In J. Voogt & G. Knezek (Eds.), International handbook of information technology in primary and secondary education. New York: Springer.
19) Wells, J. (2007). Key Design factors in Durable Instructional Technology Professional
20) Development. *Journal of Technology and Teacher Education*. Norfolk: 2007, Vol. 15, Iss. 1: pg 101, 22 pages.
21) Wimbish, J. (1992) Calculus students' difficulties in a technology-rich environment. In M. Artigue & G. Ervynck (Eds.), *Proceedings of Working Group 3 on Students' Difficulties in Calculus* (pp. 81-83). College de Sherbrooke, Quebec, Canada: 7th International Congress on Mathematical Education.

How To Cite This Article;
Kirkok, J., & Karanja, D. (2018). Readiness of Public Secondary Schools to Integrate ICT In Mathematics Teaching in Mogotio Sub-County of Baringo County, Kenya. *Journal of Education and Practices (JEPs), 1*(1), 35-43.