


# Status of ICT Infrastructure Used in Teaching and Learning in Secondary Schools in Meru County, Kenya

Timothy Ntorukiri Bariu <sup>1\*</sup> 

<sup>1</sup>Kenyatta University, KENYA

\*Corresponding Author: [tbariu493@yahoo.com](mailto:tbariu493@yahoo.com)

**Citation:** Bariu, T. N. (2020). Status of ICT Infrastructure Used in Teaching and Learning in Secondary Schools in Meru County, Kenya. *European Journal of Interactive Multimedia and Education*, 1(1), e02002. <https://doi.org/10.30935/ejimed/8283>

## ABSTRACT

ICT increases access, enhances efficiency and improves quality in education. Kenya recommended the use of the ICT infrastructure in teaching and learning in secondary schools. However, studies show that adoption rate has been very low in comparison to global demands... The study sought to investigate the state of ICT infrastructure in teaching and learning in Kenyan secondary schools. The study adopted a descriptive survey research design. Questionnaires, interviews and observation schedules were used to collect data from the respondents. Descriptive statistics in form of frequencies and percentages were used to analyze data. The study established that most schools have low investment in ICT infrastructure due to high costs of computer hardware, software and related accessories. The use of ICT infrastructure has necessitated the need for development of new skills and competencies among teachers, school heads and learners. Therefore, there is need for all stakeholders to address all the challenges that hinder use of ICT in teaching and learning so as the schools cannot lag behind since the process is in its initial stages.

**Keywords:** information, communication, technology, infrastructure, adoption, access, quality, efficiency

Received: 13 Apr. 2020 ♦ Revised: 14 May 2020 ♦ Accepted: 14 May 2020

## INTRODUCTION

Information Communication Technology (ICT) infrastructure can play a central role in transforming teaching, learning and assessment practices for teachers and students, in a high-quality 21st century education system (Tondeur, Van Keer, Van Braak, & Valcke, 2008). Globally it is recognized that teachers and schools are constantly engaged in enhancing how they teach, how their students learn and how learning is assessed. It is essential to embed ICT infrastructure in the education system all levels (Lowder & Regmi, 2020).

ICT is now pervasive in society and it continues to transform how we live our daily lives. It has the potential to support transformation in teaching, learning and assessment practices in schools and it can connect educational policy with economic and social development (Chapman & Mahlck, 2004). Similarly, there is growing evidence that digital technologies change the way students learn, the way teachers teach, and where and when learning takes place (Voogt, Knezek, Cox, Knezek, & ten Brummelhuis, 2013).

Learners need more open-ended learning experiences that develop the learners' higher-order thinking, creativity, independence, collaborating and ownership of learning. When the ICT infrastructure is used effectively, it can provide opportunities for all teachers, students and parents/guardians to develop these Key Skills (Blurton, 1999). Embedding ICT in teaching, learning and assessment is a complex

endeavour and the mere presence of ICT in a school does not equate to its effective use (OECD, 2005). In USA, Germany and Canada the 2013 ICT in Schools Census Report found that the ICT infrastructure has often taken the place of older technologies, such as books or whiteboards, and the role of the teacher and the learner remains unchanged (Tileston, 2004). Furthermore, the Horizon Report Europe 2015 K12 Edition identified main trends, developments in technology and challenges that are very likely to impact on education across the world (Fam, Palmer, Riedy, & Mitchell, 2017).

Through introduction of the ICT infrastructure in the developed countries referenced trends include rethinking how schools work and a shift from students as consumers to creators (Qablan, Abuloum, & Al-Ruz, 2009). The setbacks recognized included the rethinking of the role of teachers and scaling teaching innovations. The developed countries like, Japan, Britain, France and Germany have unanimously confirmed the potential role of the ICT infrastructure in helping to transform teaching, learning and assessment practices in a very positive way in the long run (Kopcha, 2012). In the long run, such transformation will serve to enhance student learning and prepare our young people to live, learn and work in a modern globalised society (Dunleavy, Dexter, & Heinecke, 2007).

The adoption of ICT infrastructure in secondary schools is one a key initiative that makes it possible for the education system all over the world to meet the challenges of the 21<sup>st</sup> century (Alsied & Pathan, 2013). Developed countries such China, Germany, USA and Japan have

reform programme targeting Early Years Education right through to higher education and further education and training (Tondeur et al., 2008). The implementation of ICT strategy serves to enhance continuous applications and improvement of education. Similarly, in the recent past there has been achievement in various curricula reforms taking account of the key role ICT can play in helping transform the education system so that the learners are equipped with the knowledge and skills required for the challenges posed by a rapidly changing world (Buckingham, Scanlon, & Sefton-Green, 2001).

ICT infrastructure can support more powerful and complete knowledge building experiences for learners if there are integrated well-designed technologies (Giordano, 2007). ICT infrastructure provide learning environment that allow students to learn by solving problems, to think for themselves and to collaborate with others (Kimanzi, Bwire, & Miima, 2018). They create learner centred environment by motivating learners through combining text, sound, colour and moving images that enhance content for easier learning and facilitate acquisition of basic skills through practice (UNESCO, 2008).

Generally, ICT also provide teachers with improved educational content and more effective teaching methods that improve the quality of education (Condie & Munro, 2007). They facilitate access to information and increased interest in teaching where teachers create more time to engage with students leading to greater productivity in the learning process. To implement use of the ICT infrastructure in secondary schools teaching and learning, different countries attempted to craft national policies to guide and direct ICT integration into education and social programs (Hallissy, Butler, Hurley, & Marshall, 2013). USA developed a national ICT policy that have strategies, indicators for use and objectives. In secondary schools they have incorporated technology in their programs to enhance acquisition of ICT skills by students. Computer programs and software when well-developed can aid teaching in an established education rate (e-rate) that connects schools to internet services at affordable prices.

Unfortunately, most developing countries have limited application and use of the ICT infrastructure in Education in spite of elaborate ICT policies in Education being in place. As a result, we have on one hand, the developed countries that have fully adopted digital technology and on the other hand, the developing countries (including Sub-Saharan African countries) that have lagged behind in the adoption of the digital technology.

In Africa, use of the ICT infrastructure in education is still in its initial stages and majority of the countries risk being left behind in technological advancement due to their slow pace at which they are integrating ICT in their education system (Lloyd, 2020). Unfortunately, most developing countries including Sub-Saharan Africa, for example, Uganda, Ghana, Liberia Kenya, Zambia and Sudan have limited application and use of ICT in Education in spite of elaborate ICT policies in Education being in place. Their policies are not responsive to the specific needs of education sector with emphasis on utilization of ICT for economic returns outside schools (Achimugu, Oluwagbemi, & Oluwaranti, 2010). Therefore, there is a lag in the adoption of the digital technology because they have financial problems, lack of priority towards education, myopic investment, cultural and negative attitudes towards digital world.

In Kenya, ICT policy was introduced in 2006. The mission of this policy was a 'prosperous ICT driven Kenyan society' with ICT in the centre of national development (Kashorda & Waema, 2014). The policy

aims at encouraging the use of the ICT infrastructure and promoting growth and development of e-learning across all levels of education in a bid to leverage teaching and learning (Dillon et al., 2016).

Further, the application of ICT in instructions include, use computers, CD ROMS, interactive media, modems, satellites, teleconferencing and other technological means to support learning (Tileston, 2004). The application of ICT in instruction could have several aspects which include: process of designing instructions, selection of materials and tools to design and implement a design, evaluations of designs, effectiveness of team work and use of technology in support of the development and delivery of instructions (Tondeur, Krug, Bill, Smulders, & Zhu, 2015).

MOEST Report (2006) confirms that the use of the ICT infrastructure in Kenya is facing many challenges for instance: shortage of ICT trained teachers, trained ICT personnel in the Ministry of Education Science and Technology. The limited literacy skills of teachers affect application of ICT in instruction by teachers (Hennessy et al., 2010). Similarly, many school leaders perceive the lack of ICT related knowledge as one of the main barriers to effective integration of ICT in teaching and learning (Pelgrum & Law, 2003).

ICT infrastructure has been an impediment in the adoption and integration of ICT in teaching and learning. The average access to the ICT infrastructure is one computer to 15 students in developed countries but in Africa it is very low with Kenya having an average computer student ratio of 1:45 at college level (MoEST, 2005). This low infrastructure ratio cannot support acquisition of competencies in ICT use for teaching and learning. Other studies supporting the assertion observes that teachers' beliefs, school culture, old curricula and traditional teaching approaches are other hurdles that constrain the effective use of ICT in education (Arnold & Sangrà, 2018).

Consequently, the MOEST adopted since 2000 policies that were designed to guide the use of ICT in teaching and learning (Omara, Mwalwa, & Mutisya, 2018). Students are to be enrolled in ICT courses in accordance to the demands of teachers with competencies in the use of the ICT infrastructure in teaching and learning, schools to adopt ICT syllabus prepared by MOEST, schools to be supplied with necessary and appropriate ICT infrastructure for adopting ICT in teaching and learning teachers' to undergo intensive ICT training to gain necessary skills and teachers to evaluate ICT performance of their students following the MOEST guidelines and recommendation.

Generally, evaluation of use of the ICT infrastructure in teaching and learning in secondary schools is lacking and hence impacting negatively to provision of relevant and quality education. Statistics indicate majority, (85%) of teachers lack the confidence and competencies to use ICT in teaching and learning (EMIS, 2008). Relevant data on use of the ICT infrastructure in teaching and learning in secondary schools and more so in Meru County is not provided hence the policy of ICT infrastructure provision has not been based on the needs of secondary schools. This necessitated the need to carry out research on the ICT infrastructure and its use in teaching and learning in secondary schools in Meru County.

### **Problem Statement**

The state of information and Communication Technology (ICT) infrastructure in Kenyan secondary schools has not been sustainable for a long period of time. This is revealed by the fact that majority of the schools are not fully equipped with basic ICT infrastructural facilities

necessary for teaching and learning. The ICT infrastructure in education increases access, maintains quality of education, evaluate information from different sources so as to enhance teaching and learning. According to Kenya's vision 2030 and (MoEST, 2003), if schools provide access to ICT, the quality of education will improve and the productivity will be enhanced. This in turn will develop a highly skilled manpower who can adequately respond to economic, political and social challenges of the 21<sup>st</sup> century.

However, it was noted in Meru County like other sub-counties in Kenya has limited use of the ICT infrastructure in teaching and learning as evidenced by lack of trained ICT teachers and personnel, lack of enough computer labs and computers in schools among others. Indeed, statistical data from Meru county indicated that there were only five schools using ICT out of the twenty schools in the sub-county. This is a clear indication that the use of the ICT infrastructure is almost negligible as evidenced in the fact that almost 95% of schools have not embraced use of ICT. Lack of the ICT infrastructure in education and especially to the students in Meru County has denied them the opportunity to attain the benefits associated with the use of the ICT in education. Therefore, the researcher sought to establish the status of the ICT infrastructural use in teaching and learning in secondary schools in Meru County Kenya.

### **Purpose of the Study**

To establish the functional relationships between the ICT infrastructure and the process of teaching and learning in secondary schools in Meru, County Kenya and suggests possible solutions.

## **LITERATURE REVIEW**

### **Status of the ICT Infrastructure in Secondary Schools**

ICT infrastructure refers to the hardware such as computers, scanners, photocopiers, mobile phones, printers, projectors and broadcasting technologies which include radio and TV as well as essential software that enhances teaching and learning. ICT infrastructure must be connected through computer networks and internet connectivity in order to allow for sharing and distribution of data and information among teachers and students. Researchers concurs that ICT infrastructure must be easily accessed and used by all (Özer & Yilmaz, 2011). Schools should increasingly employ multimedia applications to stimulate teaching and provide exciting opportunities activities for students (Neyland, 2011). Networked school is not just a school with a physical network, but where it is beneficial to do so, utilization of resources from outside the school's own network can be applied (Bielefeldt, 2012). Like ICT curriculum, ICT Infrastructure directly influences the outputs and outcomes of the use of ICT in teaching and learning.

Lack of ICT infrastructure could be a serious obstacle to use of ICT in teaching and learning in secondary schools, especially in developing countries like Kenya. Without ICT infrastructure, Kenya cannot integrate ICT in schools to levels expected or required. ICT infrastructure planning and investments are therefore critical if Kenya's huge economic and developmental potential are to be realized. The availability of ICT facilities in schools in Kenya is still very poor. In an attempt to investigate availability and access to the Internet, Kenya School found that email was yet to be recognized as a tool for collaboration among students and teachers (Moyo, 2009). It went on to

affirm that in the schools surveyed, access to the Internet was severely limited and when available was only for administrative use. The study found that almost 40% of these schools had less than 10 computers, and were therefore inadequate for use in teaching and learning. More than 20 per cent had less than 5 computers, indicating that the computers were mostly for administrative use. Only a third of schools studied had computer laboratories.

Implementation of the ICT infrastructure projects in selected educational institutions with a view to making recommendations on how such projects can be deployed and supported established that there was need of increased provision of ICT and in particular Computer infrastructure to schools (Dunleavy et al., 2007). The ICT would then promote utilization of ICT technologies in the provision of education to students. Therefore, the study was destined to establish whether there were ICT facilities in secondary schools in Meru County. The study established that only few schools had ICT facilities for use.

For many schools especially in the rural areas supporting infrastructure such as electricity disqualifies them even when an opportunity for donation of ICT arises. Normally, the criteria for placing computers and ICT facilities in a school are security, electricity supply and availability of ICT literate teachers among other factors (Swarts & Wachira, 2009). Due to lack of power connection to some schools, resort to the use of generators to provide electricity to power the computers (Menjo & Boit, 2010). Such sources of power are highly inconveniencing since they are normally used during the night. Consequently, few teachers are able to utilize the technology, leading to low frequency of ICT. However, a scheme meant to improve accessibility to computers by teachers has been initiated.

Teachers in public schools will be facilitated to acquire laptops through a check off system. The report observes that the initiative is meant to encourage teachers to use modems and other educational tools (Stuart, Mills, & Remus, 2009).

Maintenance of computers is vital if they are to be optimally used. In the report, an estimated 60% of the ICT infrastructure in schools is not really used due to lack of maintenance and technical support (Stuart et al., 2009). Maintenance in this case refers to actions taken on equipment and systems for example repair, upgrades, diagnostic and other preventive measures; while technical support refers to actions taken on behalf of users to keep the working or help them out of the IT systems. For example, help desk and initial training. The literature does not reveal the real significance of access in terms of availability of physical resources as a factor hindering successive use of computers in the teaching and learning process. The study established that most the ICT infrastructure facilities in the selected schools were obsolete and others had broken down and no repair.

By providing adequate and up to-date ICT infrastructural facilities, there is likelihood of staff professional development where staff learns on the job as they use them in the process of teaching in school. This would create a good working school environment where staff and students feel valued and cared for (Hennessy et al., 2010). Provision of up to-date ICT infrastructure in school would be a motivation for school staff not competent on ICT skills to train on them. The method of providing ICT infrastructure before staff undergoes training in them is becoming a popular approach in implementation of ICT in schools (Gronow, 2007). More schools are increasing ICT infrastructure without sending their staff for in-service courses, such as supplying computers to classrooms so teachers are encouraged to try them.

Through regular and consistent use of ICT hardware's, teachers and learners who are not competent in its use could develop the required skills in the use of ICT in teaching and learning in schools.

### **Use of the ICT infrastructure in Teaching and Learning Process in Secondary Schools**

It is necessary to develop a thorough rationale before beginning to use of the ICT infrastructure in schools and classrooms. Generally, with increasing availability of computer hardware it is important that teachers do not become engrossed in the machine but focus rather in their primary roles as educators. Teachers need to extend their imaginations with the awareness that as developments in computer technology occur they will be able to achieve more of their goals (Papaioannou & Charalambous, 2011).

Since the 1960's, the computer has been heralded by some as the solutions to many problems in education. Many early computer scientists saw the possibility of computer replacing teachers in schools. There are three main rationales for ICT in schools: one concerns the organizational productivity of the school and the other two focus on the needs of students: technological literacy and support for their learning. The need for ICT competent teachers stems from the need for ICT competent students and for the ICT rich learning environment that enhance students learning across the curriculum.

The field of education has been affected by ICT, which have undoubtedly affected teaching, learning and research (Smeets, 2005). ICT infrastructure has 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 (Tileston, 2004). In a rapidly changing world, basic education is essential for an individual be able to access and apply information technology.

Teaching has always been emphasizing on content. For many years course work has been revolving 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 favouring curriculum which promotes competency and performance. Curriculums have started emphasizing on capabilities and are concerned more with how the information will be used than with what the information is. Contemporary ICT is 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 curriculum that makes sound use of the affordances of these technologies (Kopcha, 2012).

The integration of information and communication technologies could help revitalize teachers and students in secondary schools. This can help to improve and develop the quality of education by providing curricular support in difficult subject areas. To achieve these objectives, teachers need to be involved in collaborative projects and development of intervention change strategies which should include teaching partnerships with ICT tools. Further, there are three conditions necessary for teachers to introduce ICT and use it in their classrooms: teachers should believe in the effectiveness of technology, should believe that the use of the technology will not cause any disturbances in students learning and finally in their control over the new technology (Cheung & Slavin, 2012). However, research studies have shown that most teachers do not make use of the potentials of ICT to contribute to quality of learning environments in spite of the value they attach to the technology (Butler, Hallissy, & Hurley, 2018).

The benefits of use of ICT technology are realized only when confident teachers are willing to explore new opportunities for changing their classroom practices by using ICT (Jamieson-Proctor, Burnett, Finger, & Watson, 2006). Consequently, use of ICT does not only enhance learning but also prepares the next generation for future lives and careers (Wondemtegegn, 2018). Changed pool of teachers will come with changed responsibilities and set of skills for future teaching involving high levels of ICT and the need for more facilitative than didactic teaching roles (Lim & Khine, 2006).

The flexibility in time-space accounted for by the integration of the ICT infrastructure into teaching and learning processes contributes to increase interaction and reception of information in education (Baskin & Williams, 2006). Such possibilities suggest changes in communication models and in the teaching and learning methods used by teachers by giving way to new scenarios that favour both individual and collaborative learning in schools. The use of the ICT infrastructure in educational setting by itself acts as a catalyst for change in the domain. ICT tools encourage and support independent learning in schools.

The influence of the technology on supporting students learning will continue increasing. 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. Learning approaches using contemporary ICT provide many opportunities for constructivist learning through their provision and support for resource-based, student centred settings and by enabling learning to be related to context and to practice (Wang & Woo, 2007).

Use of ICT infrastructure in learning settings supports various aspects of knowledge construction and as more and more students use ICT in their learning processes, the more pronounced their impact become. Teachers generate meaningful and engaging learning experiences for their students strategically using ICT to enhance learning. Students enjoy learning, and the independent enquiry which innovative and appropriate use of ICT helps to foster. The study established that very few schools were using ICT mostly for computer classes and office work.

## **METHODOLOGY**

The study used both qualitative and quantitative data. The primary data source was employed to collect first-hand information to achieve the objectives of the research. Questionnaire was the main source of the primary data. There was 276(100%) questionnaires distributed to the respondents 9(75%) principals and 36(75%) teachers Furthermore, to elucidate the problems as well as building logical frame works, Journal and research papers related to the study were analysed.

## **DISCUSSIONS**

### **Availability of the ICT Infrastructure**

The study sought to establish the availability of the ICT infrastructure in secondary schools in Meru County. A question item was put in the questionnaire-requesting respondents to indicate the

**Table 1.** Availability of the ICT Infrastructure

Respondent	Computers		Printers		Camera		Scanner		Photocopier		Internet	
	Yes %	No %	Yes %	No %	Yes %	No %	Yes %	No %	Yes %	No %	Yes %	No %
Principals	44.4	55.6	33.3	66.7	11.1	88.9	22.2	77.8	55.6	44.4	22.2	77.8
Teachers	30.6	69.4	44.4	55.6	5.6	94.4	16.7	83.3	55.6	44.4	16.7	83.3
Students	25.9	74.1	12.3	87.7	12.3	87.7	25.9	74.1	53.0	47.0	12.3	87.7
<b>Totals</b>	<b>99.9</b>	<b>199.1</b>	<b>90.0</b>	<b>210.0</b>	<b>29.0</b>	<b>271.0</b>	<b>64.8</b>	<b>235.2</b>	<b>164.2</b>	<b>135.8</b>	<b>51.2</b>	<b>248.8</b>

**Table 2.** State of the ICT Infrastructure Schools

Respondent	Computers		Printers		Camera		Scanner		Photocopier		Internet	
	Good %	Poor %	Good %	Poor %	Good %	poor %	Good %	poor %	Good %	poor %	Good %	poor %
Principals	25.0	75.0	25.0	75.0	00	100	50.0	50.0	40.0	60.0	50.0	50.0
Teachers	36.4	63.6	62.5	37.5	00	100	33.3	66.7	75.0	25.0	33.3	66.7
Students	28.6	71.4	50.0	50.0	20	80	23.8	06.2	58.9	41.1	25.0	75.0

availability of computers, printers, cameras, scanners, photocopiers and internet in their schools. The findings are presented in **Table 1**.

According to the results in **Table 1** it was noted that 55.6% of the principals' respondents indicated not having computers in their schools and 44.4% indicated otherwise, 69.9% of the teachers indicated that their schools had no computers while 30.6% indicated not to have them in their schools. Among the students 74.1% indicated that their schools had no computers while 25.9% indicated otherwise. This suggests that many secondary schools in Meru County did not have computers hence no chance of using them. This suggests that they are not using them in teaching and learning activities in their respective schools.

On printers, it was noted that 66.7% of principal respondents indicated not having them in their schools, while 33.3% indicated otherwise, 55.5% of the teachers' respondents indicated that their schools had no printers while 44.4% indicated that their schools had printers. Among the students, 87.7% respondents indicated that their schools had no printers while 12.3% indicated otherwise. This suggests that most of the secondary schools had no printers hence no chance of using them in teaching and learning.

On availability of cameras in secondary schools, 88.9% of the principals' respondents indicated not to have cameras in their schools while 11.1% indicated having them in their schools, 94.4% of the teachers indicated their schools had no cameras while 5.6% indicated having them in their schools. Among the students, 87.7% indicated there were no cameras in their schools while 12.3% indicated otherwise. This suggests that most secondary schools in Meru County had no cameras hence no chance of using them in teaching and learning. This suggests that most schools were not using ICT in teaching and learning activities.

On the area of the scanners in their respective schools, 77.8% of the principal respondents indicated not having them, while 22.2% indicated having them. 83.3% of the teacher's respondents indicated not having them in their schools while 16.7% indicated having them. Among the Form3 students, 74.1% indicated that there were no scanners in their schools while 25.9% indicated otherwise. This suggests that most schools in Meru County had no scanners hence cannot adopt them in teaching and learning in their respective schools This suggests that ICTs are not used in teaching and learning activities in secondary schools in Meru County.

On availability of photocopiers in the secondary schools, 44.4% of the principal's respondents indicated not having them in their schools

while 55.6% indicated having them, 44.4% of the teacher respondents indicated there were no photocopiers in their schools while 55.6% indicated having them. Among the students, 47% of the respondents indicated not having photocopiers in their schools while 53% indicated otherwise. This suggests that most schools in the county had photocopiers which they used in teaching and learning activities.

On the availability of the internet in the schools, 77.8% of the principals' respondents indicated not having internet in their schools while 22.2% indicated having it, 83.3% of the teachers' respondents indicated having no access to internet while 16.3% indicated having it. Among the Form 3 students' respondents, 87.7% indicated not having the internet connections in their schools while 12.3% indicated otherwise. This suggests that most schools in Meru County have no internet connections hence no chance of using it in teaching and learning activities in their respective schools. This is in line with the findings of Hennessy (2010) who established that most schools in Sub-Saharan Africa were facing problems of ICT facilities, electricity, and ICT skilled teachers. This suggests that most secondary schools in Meru County are not using ICT in teaching and learning activities.

#### State of the ICT Infrastructure in Schools

Further, the respondents who indicated that computers, printers, cameras, scanners, photocopiers and internet were available in their schools were asked to indicate their state. The findings are presented in **Table 2**.

According to the results in **Table 2**, 75% of principals' respondents indicated that the state of computers in their schools was poor while 25% indicated it was good 63.6% teachers indicated it was poor while 36.4% indicated they were good State while among form 3 students 71.4% indicated it was poor while 28.6% indicated it was good. This suggests that the state of computers in most secondary schools in Meru County is poor.

On printers, 75% of the principals' respondents indicated that the state was poor while 25% indicated it was good, 37.5% of the teachers indicate that their state was poor while 62.5% indicated that it was good, and 50% of the students' respondents indicated that their state was poor while 50% indicated it was good. This suggests that printers in most secondary schools were in working condition.

On cameras, 100% of the principals' respondents who were in agreement that cameras were available in their schools indicated that their state was poor while 0% indicated it was good, 100% of the teachers' respondents indicated it was poor while 0% indicated it was

good, 80% of the students' respondents indicated it was poor while 20% indicated it was good. This suggests that cameras in most secondary schools in Meru County were in poor state hence no possibility of being used in teaching and learning.

On scanners, 50% of the principals' respondents who were in agreement that scanners were available in their schools indicated that they were in poor state, while 50% indicated that they were in good state, 66.67% of the teachers' respondents indicated they were in poor state while 33.33% indicated they were in good state, 76.2% of the students' respondents indicated it was poor while 23.8% indicated it was good. This suggests that scanners in most secondary schools in the County are poor state hence cannot be used in teaching and learning activities.

On photocopier, 60% of the principals' respondents who were in agreement on the availability of photocopier in their schools indicated they were in poor state while 40% indicated that they were in good state, 25% of the teachers' respondents indicated it was poor while 75% indicated it was good, 41.1% of the students' respondents indicated that the state was poor while 58.7% indicated it was good. This suggests that photocopiers in most secondary schools were in good state hence a possibility of being used in teaching and learning activities in the school.

On internet, 50% of the principals' respondents who were in agreement that their schools were connected with internet indicated that it was in poor state while 50% indicate it was good state, 66.7% of teachers' respondents indicated it was poor while 33.3% indicated it was good, 75% of the students' respondents indicated it was poor while 25% indicated it was good. Watson (2009) confirms that in developing countries budgetary allocation for deploying ICT in schools' education are typically limited and given the high initial costs of setting up ICT systems, the cost factor works as a further deterrent. This suggests that the state of internet in most secondary schools in the County was poor hence not available for use in teaching and learning activities the respective secondary schools.

## CONCLUSION

### Availability of ICT Infrastructure Facilities in the Schools

On availability of, computers, printers, cameras, scanners, photocopiers and internet 55.6% of the principals' respondents indicated not having computers in their schools and 44.4% indicated otherwise, 69.9% of the teachers indicated that their schools had no computers while 30.6% indicated not to have them in their schools. Among the students 74.1% indicated that their schools had no computers while 25.9% indicated otherwise. The results show that many secondary schools in the County did not have ICT facilities hence had no chance of using them in teaching and learning activities in their respective schools.

### State of the ICT Infrastructure

The results in **Table 2** indicated that the state of computers in most secondary schools in the County was poor; internet was also poor therefore a hindrance in ICT teaching and learning.

## RECOMMENDATIONS

Based on the conclusions of the study the following recommendations can be suggested the following:

- a) The researcher recommends that all teachers in the service to be taken for refresher courses in ICT. This would equip all of them with new ICT skills which would make it easier to use the ICT infrastructure in teaching and learning in secondary schools.
- b) The government should assist secondary schools with initial the ICT infrastructure facilities. This would ensure common take off and even use of ICT infrastructure in teaching and learning in all the secondary schools.
- c) The government should ensure there are enough ICT trained technicians to repair ICT infrastructure facilities when they break down. This would ensure that once ICT facility broke down they are repaired for continuous use in teaching and learning in the schools.

## REFERENCES

- Achimugu, P., Oluwagbemi, O., & Oluwaranti, A. (2010). An evaluation of the impact of ICT diffusion in Nigeria's higher educational institutions. *Journal of Information Technology Impact*, 10(1), 25-34.
- Alsied, S. M., & Pathan, M. M. (2013). The use of computer technology in EFL classroom: Advantages and implications. *International Journal of English Language & Translation Studies*, 1(1), 44-51.
- Arnold, D., & Sangrà, A. (2018). Dawn or dusk of the 5 th age of research in educational technology? A literature review on (e-) leadership for technology-enhanced learning in higher education (2013-2017). *International Journal of Educational Technology in Higher Education*, 15(1), 24. <https://doi.org/10.1186/s41239-018-0104-3>
- Baskin, C., & Williams, M. (2006). ICT integration in schools: Where are we now and what comes next? *Australasian Journal of Educational Technology*, 22(4). <https://doi.org/10.14742/ajet.1280>
- Bielefeldt, T. (2012). Guidance for technology decisions from classroom observation. *Journal of research on Technology in Education*, 44(3), 205-223. <https://doi.org/10.1080/15391523.2012.10782587>
- Blurton, C. (1999). New directions of ICT-use in education. Retrieved on, 24, 2012.
- Buckingham, D., Scanlon, M., & Sefton-Green, J. (2001). Selling the digital dream. *ICT, pedagogy, and the curriculum: subject to change*, 20.
- Butler, D., Hallissy, M., & Hurley, J. (2018). *The digital learning framework: What digital learning can look like in practice, an irish perspective*. Paper presented at the Society for Information Technology & Teacher Education International Conference.
- Chapman, D. W., & Mahlck, L. O. (2004). *Adapting Technology for School Improvement: A Global Perspective*. ERIC.
- Cheung, A. C., & Slavin, R. E. (2012). How features of educational technology applications affect student reading outcomes: A meta-analysis. *Educational Research Review*, 7(3), 198-215. <https://doi.org/10.1016/j.edurev.2012.05.002>
- Condie, R., & Munro, R. K. (2007). *The impact of ICT in schools-a landscape review*.

- Dillon, F. R., Odera, L., Fons-Scheyd, A., Sheu, H.-B., Ebersole, R. C., & Spanierman, L. B. (2016). A dyadic study of multicultural counseling competence. *Journal of Counseling Psychology, 63*(1), 57. <https://doi.org/10.1037/cou0000118>
- Dunleavy, M., Dexter, S., & Heinecke, W. F. (2007). What added value does a 1:1 student to laptop ratio bring to technology-supported teaching and learning? *Journal of Computer Assisted Learning, 23*(5), 440-452. <https://doi.org/10.1111/j.1365-2729.2007.00227.x>
- EMIS. (2008).
- Fam, D., Palmer, J., Riedy, C., & Mitchell, C. (2017). *Transdisciplinary research and practice for sustainability outcomes*. Routledge London. <https://doi.org/10.4324/9781315652184>
- Giordano, V. A. (2007). A professional development model to promote Internet integration into p-12 teachers' practice: A mixed methods study. *Computers in the Schools, 24*(3-4), 111-123. [https://doi.org/10.1300/J025v24n03\\_08](https://doi.org/10.1300/J025v24n03_08)
- Gronow, M. (2007). *ICT leadership in school education*. Paper presented at the Australian Catholic University Conference July–August.
- Hallissy, M., Butler, D., Hurley, J., & Marshall, K. (2013). Redesigning education: Meeting the challenges of the 21st century. Retrieved November, 26, 2013.
- Hennessy, S., Onguko, B., Harrison, D., Ang'ondi, E. K., Namalefe, S., Naseem, A., & Wamakote, L. (2010). Developing the use of information and communication technology to enhance teaching and learning in East African schools: Review of the literature. *Centre for Commonwealth Education & Aga Khan University Institute for Educational Development–Eastern Africa Research Report, 1*.
- Jamieson-Proctor, R. M., Burnett, P. C., Finger, G., & Watson, G. (2006). ICT integration and teachers' confidence in using ICT for teaching and learning in Queensland state schools. *Australasian Journal of Educational Technology, 22*(4). <https://doi.org/10.14742/ajet.1283>
- Kashorda, M., & Waema, T. (2014). E-Readiness survey of Kenyan Universities (2013) report. *Nairobi: Kenya Education Network*.
- Kimanzi, P. R., Bwire, A., & Miima, F. (2018). *Influence of Teacher Feedback Techniques on Students' Essay Writing Skills in English Language in Secondary Schools in Nairobi County, Kenya*. School of Education. Department of Educational Communication and Technology.
- Kopcha, T. J. (2012). Teachers' perceptions of the barriers to technology integration and practices with technology under situated professional development. *Computers & Education, 59*(4), 1109-1121. <https://doi.org/10.1016/j.compedu.2012.05.014>
- Lim, C. P., & Khine, M. (2006). Managing teachers' barriers to ICT integration in Singapore schools. *Journal of technology and teacher education, 14*(1), 97-125.
- Lloyd, I. (2020). *Information technology law*: Oxford University Press.
- Lowder, S. K., & Regmi, A. (2020). *Assessment of outcomes based on the use of PIM-supported foresight modeling work, 2012-2018*: Intl Food Policy Res Inst. <https://doi.org/10.2499/p15738coll2.133608>
- Menjo, D. K., & Boit, J. M. (2010). The challenges of using information communication technology (ICT) in school administration in Kenya. *Journal of African Studies in Educational Management and Leadership, 1*(1).
- MoEST. (2003).
- MoEST. (2005). *School factors influencing adoption of information communication technology in teaching and learning in secondary schools in Wetlands, Kenya*. University of Nairobi,
- Moyo, L. (2009). The digital divide: Scarcity, inequality and conflict. *Digital cultures: Understanding new media, 122-139*.
- Neyland, E. (2011). Integrating online learning in NSW secondary schools: Three schools' perspectives on ICT adoption. *Australasian Journal of Educational Technology, 27*(1). <https://doi.org/10.14742/ajet.989>
- OECD. (2005). E-learning in tertiary education [Online]. (.)
- Omare, W., Mwalwa, S., & Mutisya, S. (2018). *Challenges Facing Utilization of ICT in Public Secondary Schools in Kajiado North Sub-county, Kenya*.
- Özer, G., & Yilmaz, E. (2011). Comparison of the theory of reasoned action and the theory of planned behavior: An application on accountants' information technology usage. *African Journal of Business Management, 5*(1), 50-58.
- Papaioannou, P., & Charalambous, K. (2011). Principals' attitudes towards ICT and their perceptions about the factors that facilitate or inhibit ICT integration in primary schools of Cyprus. *Journal of Information Technology Education: Research, 10*(1), 349-369. <https://doi.org/10.28945/1530>
- Pelgrum, W. J., & Law, N. (2003). *ICT in education around the world: Trends, problems and prospects*: UNESCO: International Institute for Educational Planning.
- Qablan, A. M., Abuloum, A., & Al-Ruz, J. A. (2009). Effective integration of ICT in Jordanian schools: An analysis of pedagogical and contextual impediments in the science classroom. *Journal of science education and technology, 18*(3), 291-300. <https://doi.org/10.1007/s10956-009-9151-9>
- Smeets, E. (2005). Does ICT contribute to powerful learning environments in primary education? *Computers & Education, 44*(3), 343-355. <https://doi.org/10.1016/j.compedu.2004.04.003>
- Stuart, L. H., Mills, A. M., & Remus, U. (2009). School leaders, ICT competence and championing innovations. *Computers & Education, 53*(3), 733-741. <https://doi.org/10.1016/j.compedu.2009.04.013>
- Swarts, P., & Wachira, E. (2009). Kenya: ICT in education situational analysis. *Global e-schools and Communities Initiative*.
- Tileston, D. W. (2004). What Every Teacher Should Know About Learning. *Memory, and the*.
- Tondeur, J., Krug, D., Bill, M., Smulders, M., & Zhu, C. (2015). Integrating ICT in Kenyan secondary schools: an exploratory case study of a professional development programme. *Technology, Pedagogy and Education, 24*(5), 565-584. <https://doi.org/10.1080/1475939X.2015.1091786>
- Tondeur, J., Van Keer, H., Van Braak, J., & Valcke, M. (2008). ICT integration in the classroom: Challenging the potential of a school policy. *Computers & Education, 51*(1), 212-223. <https://doi.org/10.1016/j.compedu.2007.05.003>
- UNESCO. (2008). *Education for All Global Monitoring Report 2008: Education for All by 2015. Will We Make It?*: Oxford University Press.

- Voogt, J., Knezek, G., Cox, M., Knezek, D., & ten Brummelhuis, A. (2013). Under which conditions does ICT have a positive effect on teaching and learning? A call to action. *Journal of Computer Assisted Learning*, 29(1), 4-14. <https://doi.org/10.1111/j.1365-2729.2011.00453.x>
- Wang, Q., & Woo, H. L. (2007). Systematic planning for ICT integration in topic learning. *Journal of Educational Technology & Society*, 10(1), 148-156.
- Wondemtegegn, S. A. (2018). University Students Perception and Utilization of Technology for Learning: The Case of Haramaya University. *Online Journal of Communication and Media Technologies*, 8(1), 130-149. <https://doi.org/10.29333/ojcm/2367>