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Influence of Availability of Information Communication Technology on Integration in Biology Teaching in Public Secondary Schools in Kiambu County, Kenya

By

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Abstract

Life in 21st century is characterised by use of Information Communication Technology (ICT). Education sector has embraced ICT use by both the teachers and learners. The purpose of this study was to investigate the influence of availability of ICT on their integration in biology teaching in public secondary schools in Kiambu County, Kenya. The objectives of the study were, to: Assess the availability of ICT resources in public secondary schools in Kiambu County, Kenya; determine the influence of availability of ICT on their integration in biology teaching in public secondary schools in Kiambu County, Kenya. This study was anchored on Technology Pedagogy Content Knowledge (TPACK) theory which provided the theoretical base for the current study. The study was guided by both qualitative and quantitative paradigms and *Ex-post facto* research design was adopted to guide the study. The target population of the study was 521 teachers of biology in Kiambu County public secondary schools. The sample size was 167 teachers of biology. The sample was selected using stratified random sampling and purposive sampling methods. The researcher also used simple random sampling technique to select three teachers in schools with more than three teachers of biology. The sample size was determined by use of Krejcie and Morgan table. The data was collected by use of teacher questionnaires. Reliability was determined using the test-retest method and coefficient of 0.792 was obtained. The data obtained from the study was analysed by use of both descriptive and inferential statistics. Pearson correlation and simple regression analysis test were used to test the hypotheses at significance level of .05. Statistical package for social sciences (SPSS) version 26 was utilized to analyse data. The study established that public secondary schools in Kiambu County had fairly adequate ICT resources for use in biology teaching. In addition, the study also established that availability of ICT in public secondary schools had a statistically significant influence on integration of ICT. Conclusion made is that availability of ICT resources made a significant contribution on the integration of ICT in biology teaching in public secondary schools in Kiambu county, Kenya. The study recommends that Public Secondary Schools should be empowered to make ICTs available for integration process to be successful.

Key words: ICT, Availability, Influence, Integration, Biology, Teaching, Secondary schools, Kenya

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Introduction

Tapera and Kujeke (2019) defines Information and Communication Technology (ICT) as a type of technology that supports activities involving information, such as gathering, processing, storing and presenting data. They observe that ICT can be used to teach in all levels of education effectively. Chacha and Kitula (2022) posits that educational system has felt the impact and influence of ICT which has become a crucial factor for most organizations and businesses. Amini and Oluyide (2020) postulates that a number of factors influence integration of ICT in teaching and learning where availability is one of them. In addition, Reiser and Salisbury (2015) identified availability as a factor that influence integration of ICT in teaching. The researchers further argued that time for planning; personal exploration, online access, and skill development are limiting factors to integration of ICT. Reiser and Salisbury concludes that integration does not just happen in a vacuum but it is influenced by a score of factors that may accelerate it or slow it down and availability is one of the factors. The current study investigated influence of availability of ICT on integration of ICT in biology teaching in public secondary schools in Kiambu County.

Statement of the Problem

Despite ICT having found its use in all sectors of economy, its integration in teaching in secondary schools has remained an area of concern in Kenya with Kiambu County being no exception. Many studies have shown that integration of ICT in teaching is influenced by several factors where availability is one of them. Influence of availability of ICT on integration of ICT in biology teaching in public secondary schools is the gap that the study has filled.

Objectives

i) To assess the availability of ICT resources in public secondary schools in Kiambu County, Kenya.
ii) To establish whether availability of ICT in schools has any influence on integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya.

Hypothesis

HO_1: Availability of ICT has no statistically significant influence on integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya.

Theoretical Framework (The Technology Pedagogy Content Knowledge (TPACK) Theory by Mishra (2019)

The proponent of this theory is Shulman (1986) who conceptualized the theory in form of a model which has Technology, Pedagogy and Content Knowledge (TPACK). This TPACK theory was further popularized by Rosenberge and Koehler (2015) who improved on it by showing the relationship between technology, pedagogy and content knowledge.

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According to Herring et al., (2016) the TPACK model describes the inter-relationship between content, pedagogy and technology, and emphasizes on integration of the three areas in developing effective teaching for learning. Knowledge of content (C) in the model is an understanding about subject matter. Teachers of biology must be knowledgeable in what they are teaching this include the facts, concepts, principles, theories and procedures. Pedagogical knowledge (P) is knowledge about teaching. Teachers of biology need to know how learning takes place; for example, how students construct knowledge and what a cognition process is, methods of teaching, student assessment, instructional design and classroom interactions. In the use of ICT in biology teaching in secondary: Technology and pedagogy management are also elements of pedagogical knowledge. Technology knowledge (T) involves the awareness of and skills in operating and applying technology such as computer software, the internet and liquid crystal display (LCD) projectors.

Pedagogical content knowledge exists in the intersection of content and pedagogy and it is the knowledge about teaching specific subject matter (Mishra, 2019). It is concerned with the arrangement of content, the representation and formulation of the subject, the analogies and demonstration of ideas in easily comprehensible ways for learners.

Technological content knowledge associates the application of technology in teaching subject matter of biology. An example of technological content knowledge is the understanding of statistical computer software (such as SPSS) and their applications into the subject matter. Technological pedagogical knowledge, an overlapped area between the technology and pedagogy circles, refers to the ability of using technology in a way that supports the pedagogical approach. An understanding about existing technologies such as MS PowerPoint, digital cameras, animations and WebCT as well as the capabilities of utilizing them in teaching is illustrative of technological pedagogical knowledge (Rana et al., 2022). The Figure that follows shows the interrelationship between various knowledge as depicted by TPACK theory.

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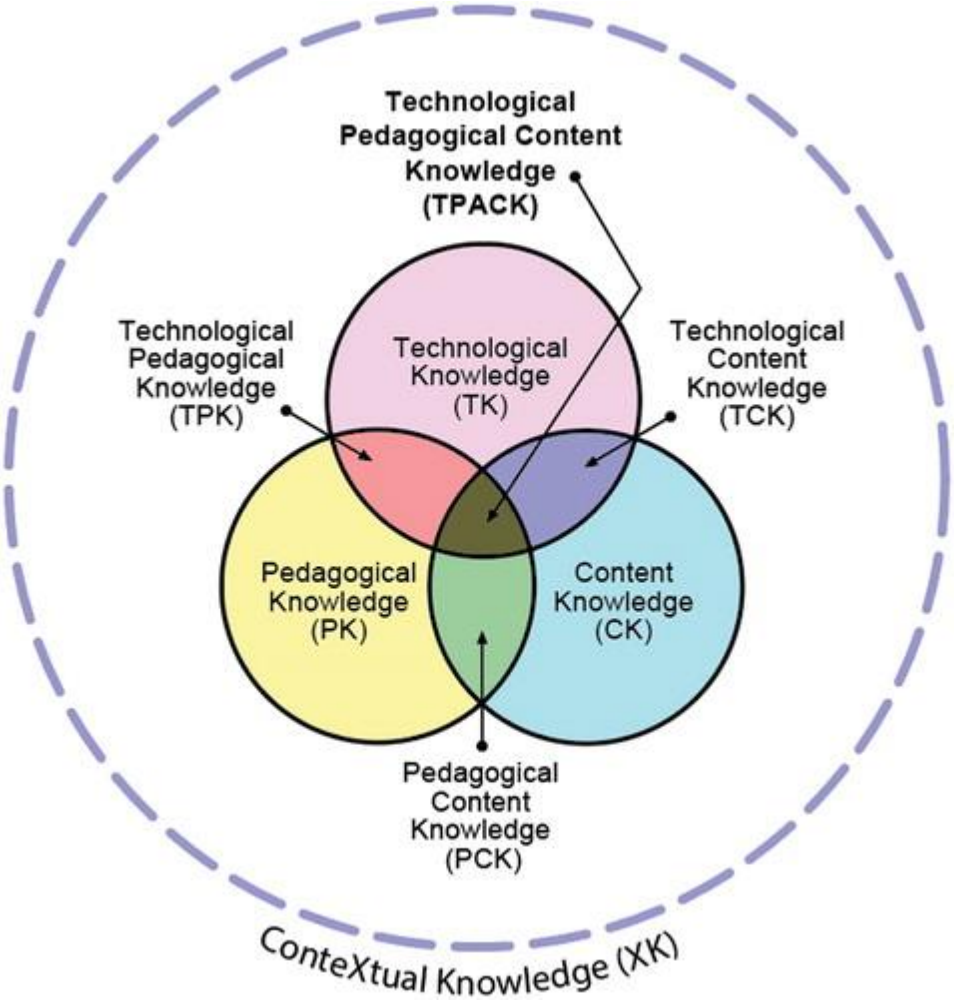

Figure 1: Revised version of the TPACK model.
Source: Adopted from Mishra (2019).

Figure is a Venn diagram. It's derived from mathematical concept of sets. As illustrated in the center of the model, technological pedagogical content knowledge, an emerged form of knowledge, is essential for successful application of ICT in teaching (Mishra, 2019) and is the focus of this study. It is the integration of teachers' understanding about the subject, knowledge about teaching and learning, and the ability of using technology. Thus, technological pedagogical content knowledge is the knowledge of how to teach the content of subject matter using technology in a way that facilitates learning. Each circle represents a type of knowledge.

According to Mishra (2019) The outer dotted circle "Contextual Knowledge" (i.e., the teacher's knowledge of the context) is everything from a teacher's awareness of available technologies, to the teacher's knowledge of the school, zone, sub-County, nation, or national policies of education they operate within.

The benefit to Contextual Knowledge is that it makes the outer circle another knowledge domain that teachers must possess to integrate technology in teaching. This, in turn, implies that contextual knowledge is something that teachers of biology can act on,

change, and develop. Just as teachers of biology seek to develop teachers' knowledge types and overall TPACK, it becomes clear that teachers ought to work toward increasing their contextual knowledge as well. Contextual knowledge therefore becomes of critical importance to teachers, and a lack of it limits the effectiveness and success of any TPACK development and teacher's attempts at technology integration. This outer dotted outer circle is named XK for "conteXtual Knowledge" in order to distinguish it from content knowledge (CK). Mishra (2019) notes that using X for conteXtual is very appropriate because X usually denotes a variable, and contextual knowledge often is highly variable.

The theory implies that the balance of technology, pedagogy and content knowledge are essential for success in effective biology teaching using ICT. It's evident that the teacher should have acquired knowledge of the content, pedagogy and technology. These are confined in the teacher while availability of ICT is also essential for them to be used and these forms the selected factors. The outer dotted circle encloses a space but it is not designated as a form of knowledge. It is labelled "Context" or "Contexts." Since TPACK is a framework for teacher knowledge, maintaining semantic consistency requires that every enclosed space represent some aspect of teacher knowledge. That works for TK, PK, and CK (and the overlaps, TCK, PCK, TPK, and TPACK) and should for the outer dotted circle too.

The TPACK theory has excellently explained interaction of the three spheres of knowledge and how they blend to enable a teacher of biology integrate ICT in teaching. The theory has shown that availability of ICT has a great significance in biology teaching in public secondary schools in Kiambu County.

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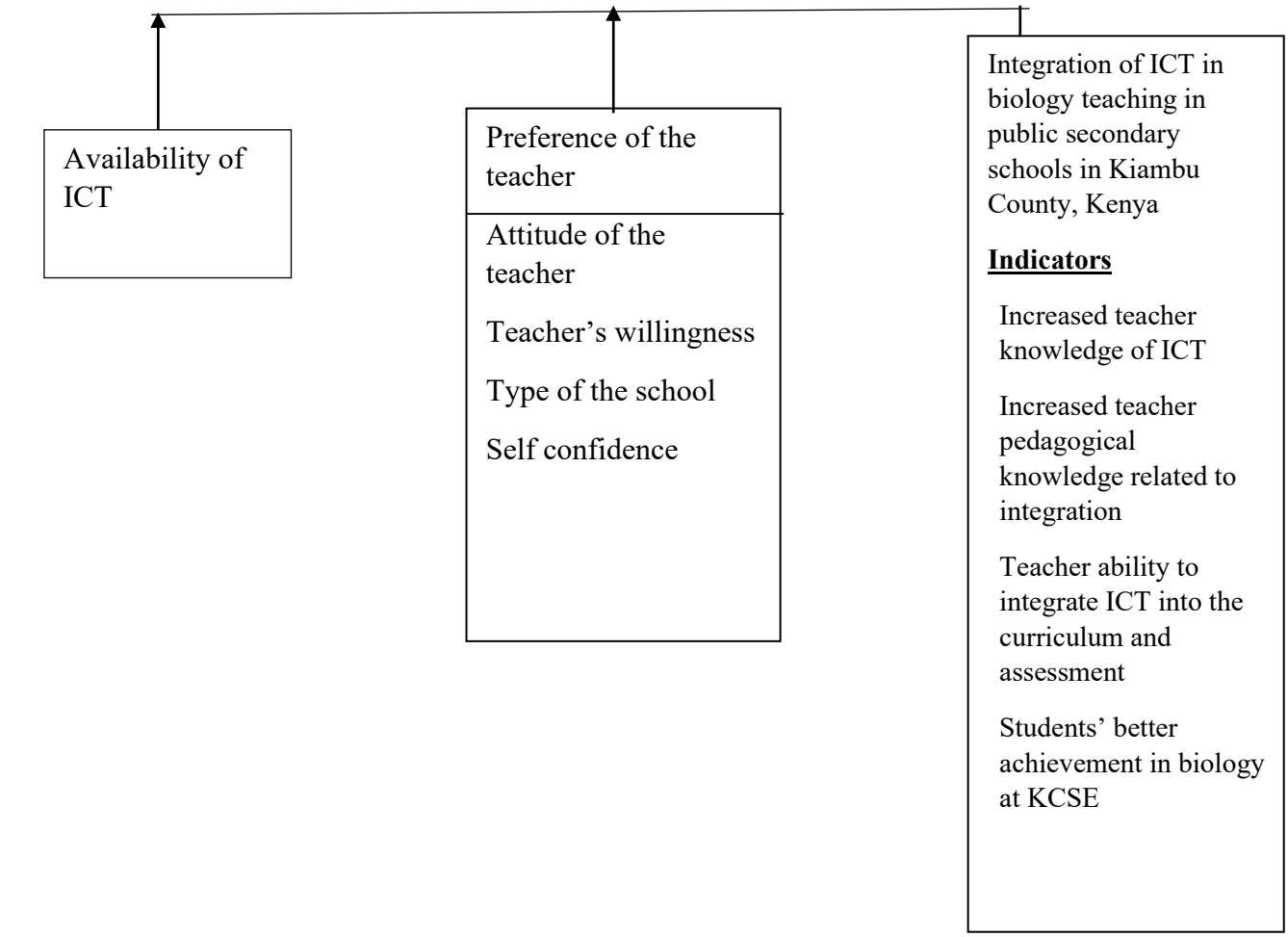
Conceptual Framework

Kombo (2006) affirmed a conceptual framework as a research tool intended to assist a researcher develop awareness and understanding of the situation under scrutiny and communicate it effectively. This shows that integration is a process that takes place over time rather than a particular time. It also indicates that integration of ICTs is influenced by availability of ICT.

Figure 2 *Subsumed in Interrelationship Between Variables in the Study*



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Review of related literature on availability of ICT and Integration of ICT in Biology teaching in public secondary schools in Kiambu County, Kenya.

Bahia et al. (2020) did a study in Spain on use of ICT in society and postulated that the availability of a resource is the first step towards its use. In support of this, Li et al. (2018), observed that the availability of ICT in Malaysian secondary schools seriously limited what a teacher can do in the classroom with regards to integration. Far from Asia and Europe, Pang et al. (2022) did a study in United States and noted that teachers used computers for teaching since they were available in their places of work. In addition, Richardson (2023) notes that American secondary schools have successfully integrated ICT in teaching mostly due to the availability of the computers. In support Ravy (2020) did a study in Syrian secondary schools and observed that teachers comfortably integrated ICT in teaching since computers were at their disposal. In addition, the study noted that teachers used computers for their own work outside the school. Ravy through his findings concluded that the main obstacle to technology integration in teaching worldwide is availability.

Looking at availability and funds Munyemana et al. (2022) and Shengru (2018), stated that many scholars proposed that the lack of funds to obtain the necessary hardware and software is one of the reasons why teachers do not use technology in their classes. Also, a report on teachers' use of technology by the National Center for Education Statistics in United States indicates a positive correlation between availability of computers and computer use (Trucano, 2016). A study on effects of availability of computers on integration in Saudi Arabia Universities, by Mahdi and Dera (2014), found out that 78% of teachers surveyed cited limited access to computers as a major barrier to effectively integrating them in their classes. Of this, 38% thought inadequate computers were a great barrier to using technology in their classes. Therefore, efficient and effective use of technology by a large extent depends on the availability of hardware and software.

The situation is different in African countries where computers are insufficient. For instance, The African Union (2022) Digital Education Strategy and Implementation Plan states that the African Union (AU) recognizes that digitalization is a tool for addressing the challenges in the education sector and a driving force for innovation. The AU Agenda 2063 states that "well-educated and skilled citizens, underpinned by science, technology and innovation for a knowledge society. A study done in Nigeria by Karna (2021) showed that insufficient numbers of computers prevent teachers from using computers for teaching. This is because the computers are out of reach for the teachers. Karna further observes that some African countries are trying hard to see that integration of ICT is achieved though they are still far. According to Fomunyam (2019), statistics on the efforts to use ICT in education indicated that Egypt with a total of 32,120 schools had 10,000 computers, Namibia with 1,520 schools had 60 and Ghana with 35,000 had 5000 computers. Insufficient numbers of computers and other related ICT resources hinder teachers from using computers for teaching (Karna et al, 2022).

Obonyo (2019) noted that in Africa especially rural areas have many challenges such as electricity connection, network configuration, frequent power break downs and power cuts that increase cost of ICT infrastructure making rural areas almost impossible to access and integrate ICT in the teaching process. According to MoE (2021) availability of ICT resources is one of the major challenges facing their integration in education in Africa, Kenya being no exception. MoE denotes that while the ratio of one computer to 15 students is the norm in most developed countries, the ratio in Africa stood at one computer to 150 students and it is even bigger in disadvantaged regions and areas. In Kenya, the ratio for universities and

colleges was one computer to 45 students, Ministry of Education: Policy on Information and Communication Technology in Education and Training notes that there is one computer to 120 students at secondary school level while access at the primary school level remained much more limited at one computer to 250 students. (MoE 2019). According to the e-readiness survey conducted in 2016, secondary schools have a computer to student ratio of 1:92. In TVET, the student to computer ratio ranged from 1:40 to 1:50 (ICT Infrastructure Review Report, 2017). According to Miima (2014) Kenyan schools are under equipped with ICT. The researcher further notes that this could be one of great hindrances to integration of ICT in secondary schools (Miima, 2014). Kanyoi (2019) posits that many public secondary schools in Kenya have inadequate ICT resources for use in teaching and learning.

In conclusion, lack of ICT limit teachers uses and poses a huge barrier to its integration in schools. Teachers who have computers in their classes are more likely to use them for instruction than teachers who do not have them. In the current study, the researcher investigated influence of availability of ICT on biology teaching in public secondary schools of Kiambu County, Kenya.

Methodology

Research Design

The study adopted the *ex-post facto* research design. An *ex-post facto* research design integrates different methods in collecting data required in a study (Plowright, 2011). According to Kothari, (2011) the design includes reporting what has happened or happening without interfering with given variables. Kothari asserts that, it is also concerned with describing, recording and reporting conditions as they exist. In *ex-post facto*, a researcher can generally discover causes even when he/she cannot control variables. This study explored the influence of availability of ICT on integration of ICT in biology teaching in public secondary schools in Kiambu County.

The target population in this study was teachers of biology in public secondary schools in Kiambu County. This is because the study focused on the integration of ICT in biology teaching in public secondary schools. The target population was 521 teachers of biology in Kiambu County teaching in 291 public secondary schools which have up to form four and taking KCSE. Given the nature of the problem under investigation, that is influence availability of ICT on integration in biology teaching in public secondary schools, the study used teachers as units of study due to the fact that they were the point of focus and they were the ones expected to integrate the ICT in biology teaching.

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Table 1: Distribution of Target Population

School Categories	Teachers of biology	Total
National	32	38
Extra- County	76	95
County	109	162
Sub-County	304	517
Total	521	812

Source: Field Data 2024

Sample Size

Ary et al. (2006) define a sample as a small group obtained from accessible population. On the other hand, Orodho (2009) simply defines a sample as a sub-set of a population. In order to represent salient characteristics of the accessible population and to reduce sampling error, a sample must be large enough (Mugenda & Mugenda, 2012). The researcher used Krejcie and Morgan (1970) table of determining sample sizes for different populations to determine the sample size for this study. The sample size of this study was 167 teachers of biology in the County.

Sampling Procedure

According to Kothari (2011), sampling is a research technique used for selecting a given number of subjects from a target population. Stratified random sampling method and simple random sampling were used to sample 93 public secondary schools. All the public secondary schools in the County were placed in four strata namely, National, Extra-County, County and Sub-County. The public secondary schools were then selected from each stratum by use of simple random sampling method. There were six National schools, 19 Extra-County, 53 County schools and 213 Sub-County public secondary schools in the County hence a total of 291 public secondary schools taking KCSE. The sample included two National schools, six Extra-County, 17 County and 68 Sub-County public secondary schools. Therefore, a total of 93 public secondary schools were sampled (Krejcie & Morgan,1970). Teachers of biology in these schools were used as the study units. The teachers sampled were teaching biology at the time of collecting data and were sampled purposively. The researcher purposively sampled teachers of biology where in a school with only one teacher, he/she was sampled. In schools with more than one teacher of biology, the researcher selected the ones who were teaching form three at the time of collecting the data. However, schools from extra-county and county with more than three teachers teaching biology in form three, the researcher selected three teachers only. For the national schools the researcher purposively sampled five teachers of biology from each of the two national public secondary schools. The researcher used simple random sampling to select five teachers from national schools category and three teachers in county and extra-County categories. The researcher wrote names of the form three teachers teaching biology and placed them in a basket and selected any three for county and extra- county and for national schools, he selected any five. The

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teachers selected, responded to the questionnaire used in this study. Table that follows give the information on sample of teachers of biology and principals in the study.

Table 2: Sampling Frame

Category of respondents	Category of schools	Total (N)	Sample (n)
Schools	**National**	**06**	**02**
	Extra- County	**19**	**06**
	County	**53**	**17**
	Sub-County	**213**	**68**
Total		**291**	**93**
Teachers	**National**	**32**	**10**
	Extra-County	**76**	**24**
	County	**109**	**35**
	Sub-County	**304**	**97**
Total		**521**	**167**

Source: Field Data 2024

Table 2 indicates that, a total of 93 schools were selected for the study out of a total of 291schools. Majority of the schools were Sub-County that is 68. This is because Sub-County public secondary schools are majority in the County as compared to the other categories. The second were the Extra-County schools which gave six schools while County category contributed 17 schools and eventually the Sub-County category gave 68 public secondary schools. (Krejcie & Morgan,1970).

Instrumentation

The instruments used in the study were questionnaires. The researcher used teachers questionnaires. The objectives of the study formed the basis on which, the research instruments were constructed. The instrument was developed so as to contain all the items that would aid in achieving the objectives of the study. The study answered the question on the influence of availability of ICT on integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya.

Data Analysis

According to Kothari (2011), mass data collected during the research process may have little meaning unless the investigator summarizes it into a form that is analyzable for the purpose of writing the final report. In this regard, raw data collected by use of questionnaires were converted into codes where each code represented a response category and manually transferred to code sheet. Data analysis was done by both descriptive and inferential statistics that included frequencies, arithmetic means, percentages, Pearson correlation and simple regression were done based on the research questions of the study. The Statistical Package for Social Sciences (SPSS) version 26 was used as a tool for data analysis.

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Results

The researcher collected data on the ICT resources available in sampled public secondary schools in Kiambu County. The results are as shown in table 3 that follows.

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Table 3: The Distribution of the Descriptive Statistics on Availability of ICT Resources in the Sampled Schools

		Not available at all	Inadequate	Fairly adequate	Adequate	Total	Mean	Std. Deviation
Availability of computers	Sub-county	0	14	30	30	74		
	County	0	6	12	12	30		
	Extra county	0	4	15	5	24		
	National	0	0	1	4	5		
Total		**0**	**24**	**58**	**51**	**133**	**2.20**	**0.726**
Availability internet	Sub-county	8	3	30	33	74		
	County	0	4	9	17	30		
	Extra county	0	6	14	4	24		
	National	0	1	1	3	5		
Total		**8**	**14**	**54**	**57**	**133**	**2.20**	**0.860**
Availability of digital cameras	Sub-county	17	47	5	5	74		
	County	9	19	1	1	30		
	Extra county	7	10	3	4	24		
	National	0	0	1	4	5		
Total		**33**	**76**	**10**	**14**	**133**	**1.04**	**0.865**
Availability of projectors	Sub-county	3	33	8	30	74		
	County	1	3	9	17	30		
	Extra county	2	3	7	12	24		
	National	0	3	2	0	5		
Total		**6**	**42**	**26**	**59**	**133**	**2.04**	**0.972**
Availability interactive whiteboard	Sub-county	46	10	2	16	74		
	County	19	0	3	8	30		
	Extra county	13	2	3	6	24		
	National	1	1	2	1	5		
Total		**79**	**13**	**10**	**31**	**133**	**0.95**	**1.269**
Availability of a computer laboratory	Sub-county	34	20	8	12	74		
	County	1	8	16	5	30		
	Extra county	3	12	8	1	24		
	National	1	1	1	2	5		
Total		**39**	**41**	**33**	**20**	**133**	**1.26**	**1.042**
Availability of video conferencing equipments	Sub-county	44	18	9	3	74		
	County	25	4	1	0	30		
	Extra county	18	3	1	2	24		
	National	1	0	0	4	5		
Total		**88**	**25**	**11**	**9**	**133**	**0.56**	**0.908**

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From analysis in Table 3, it can be observed that national public secondary schools a large majority 75% of the respondent teachers stated the computers were available and only 25% stated that they were fairly adequate. However, in extra-county schools, majority of teachers of biology felt that the computers were fairly adequate 62.5% while 20.9% felt that they were adequate and 16.6% were for the idea that they were inadequate. All the sampled extra-county schools had computers. The situation in sub-county schools was that 19% had inadequate computers while 40.5% had fairly adequate and another 40.5% had adequate computers. In summation it was found that all public secondary school sampled in Kiambu County had computers for use in biology teaching. From the questionnaires, no particular respondent said their school had no computer at all. This confirms the notion that Kiambu county is well endowed with resources and all public secondary schools have installed computers which may favour the integration of ICT in biology teaching.

A study by Song et al. (2021) concludes that the availability of computers affects the level and process of ICT integration in teaching. Another study Saber (2021) indicate that lack of computers is a major barrier to the integration of technology by teachers. These findings also concur with Ntorukiri et al. (2021) findings that 87% of secondary schools in Meru had computers and Wanga (2014) who found that 91% of public secondary schools in Gilgil Sub-County had computers. Respondents agreed with a mean of 2.20 and a standard deviation of 0.726 that the computers available in their schools were fairly adequate. The current study has also found that 100% of the schools had computers at their disposal for use by the teachers of biology. The current study was taken in the year 2023 and considering the price of computers has drastically reduced in recent past years and hence acquisition of the same have become relatively easier. The findings may agree with other counties within Nairobi metropolitan region but may not be in tandem with other rural counties.

Considering the numerous benefits that internet has and its impact on teaching, the researcher found it important to assess its availability in the sampled public secondary schools. It was found that availability of internet was fairly adequate as evident by a mean of 2.20 and a standard deviation of 0.860. Internet is a powerful resource when availed for use Mogeni (2020) in support argue that by connecting computers to the internet in schools, the computers are transformed into powerful communication devices with countless teaching applications. There is need therefore for schools to invest in the installation of internet. Schools' administrations need to be sensitized of the subsiding costs of internet connectivity for teaching and the enormous benefits offered by such connection.

Internet is an essential resource for biology teaching. It can be used to download teaching materials such as images of organisms not found within Kiambu County and videos to facilitate productive interactions, finding new sources of knowledge, extending classroom interactions, doing research, sourcing for biology projects, and collaborative learning in biology. The schools in the County had a fairly available internet for use by the teachers of biology. These findings were not in agreement with those of Kirimi (2014) who found that Majority (72%) of secondary schools in Murang'a had no internet connection in their schools. And only 28% of schools had internet connections. Owiti (2019) did a study on use of ICT in teaching and learning of secondary schools biology in Migori county, Kenya and found out that three quarters (75%) of the secondary schools had no internet connectivity which is necessary for information and data retrieval (Owiti, 2019) which implied that teachers were unable to access various sources of information which they could present to the learners during the actual teaching for better results in terms of students' performance.

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According to Kunda et al. (2018), internet use enhances collaborative development of skills and abilities to create knowledge among the learners. Efficient use of the internet brings a better preparation for the students, lifelong learning and better opportunity to join the job industry. Owiti posits that the aim of integrating ICT in instruction mainly should be as a teaching aid for existing subjects. Use of ICT therefore in biology instruction can bring about improvement in learners' performance. In support of this, Mutai et al. (2020) notes that ICT integration enables students to transfer gained experiences to real life situations and daily applications. Moreover, learners would be able to use ICTs responsibly and effectively if they are exposed to relevant experiences during learning. Maupa, and Goronga (2023) notes that, use of the internet improves the quality of learning that will translate in high achievement. This view is supported by Daniel and Khaemba (2021) who argues that the internet offers opportunities for active and collaborative learning with the other related benefits. The benefits include but not limited to; an environment that is inviting and well-organized, learning activities that are student-centered and adapted to learning needs and preferences, monitoring of students' progress through multiple pathways, supporting the teaching and learning environment for technology and instruction work together in support of the teachers and students.

The study also differs with another that was done by Minae (2014) on access and pedagogical integration of information and communication technology in secondary schools in Nairobi and Kiambu Counties: The Case of Computers for Schools Kenya and found that only 39.2% of the schools were connected to the internet. The disparity in the finding may have been brought by the availability of cheap internet connections from the Internet Service Providers (ISP) in last recent past. In the same line, today one can use a modem or a smart phone to provide internet to the computer also called hotspot. The price and time could be two major contributing factors to the increased internet connectivity in the schools in Kiambu County. In addition, Kiambu County is better endowed in terms of resources than majority of rural designated Counties. From the foregoing, it is evident that some of the teachers in the sampled schools did not easily access or never accessed the internet while in school. It is possible to imagine that mostly the ICT facilities were therefore accessed and used for other activities that are not supported by the internet. Some schools therefore in the study are those that miss out on the numerous benefits of the use of internet in teaching and learning.

Another ICT resource that the researcher was interested in was the projector. There are four different types of projectors in Kenyan market today. These are Liquid Crystal Display (LCD), Light Emitting Diode (LED), Digital Light Processing (DLP) and Liquid crystal On Silicon (LCOS). The researcher was not interested with the type of the projector but its availability for use by the teachers of biology. A projector can be used by a teacher of biology to increase students' engagement by allowing them to collectively participate in presentations such as video, games, content and other group activities all in one session. In addition, a teacher can access different elements of a lesson such as a lesson plan and lesson notes by just plugging a USB directly into the projector. In a summation, projectors provide a big screen for view by the learners Owiti (2019). The data gathered shows that projectors were available and fairly adequate. This was shown by a mean of 2.04 and a standard deviation of 0.972. Public secondary schools in Kiambu therefore have projector required for teaching.

Interactive white board (IWB) is also known as smart or living board. Sun et al. (2022) defines it as a large, touch-sensitive board, which is connected to a digital projector and a computer. The projector displays the image from the computer screen on the board. The

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computer can then be controlled by touching the board, either directly or with a special pen. Unlike any other teaching tools, Interactive Whiteboard is definitely the most interactive tool ever used in the classrooms for teaching. Compared to ordinary PowerPoint presentation slides, teachers and student are given the chance to interact during lesson in. The teachers can always invite their students to the front and ask them to write or draw on the board, drag and drop words or images into specific locations on the board and numerous more activities. The ability of the tool to sense touch and different colours input makes it attractive, easy and effective for the students to use and experience.

In an Interactive Whiteboard study by Krithika and Devi (2023). the findings suggest that the board makes a difference to aspects of classroom interaction where there are more interactions between teachers and students in the IWB lessons compared to the non-Interactive whiteboard lessons. A research study by Sun et al. (2022) indicated a result that the usage of Interactive Whiteboard has risen student achievement by 16 percent. IWB is therefore an essential ICT tool to be integrated in biology lessons. From the current study, 60% of the sampled schools had not installed IWB while 10% were inadequate, 7.5 were fairly adequate and only 22% had adequate. This means that 88% of all public secondary schools in Kiambu County may miss the benefits brought by use of IWB in education since they did not have adequate IWB in the school. This is therefore a research gap where one can look at the influence of IWB to teaching in the county.

Digital camera is an electronic device which produces digital images that can be stored in a computer and displayed on screen. The researcher investigated adequacy of digital cameras for use in biology teaching in public secondary schools in Kiambu County. The data obtained depicts that, 25% of the schools sampled had no digital cameras at all, 57% had digital cameras but they were inadequate, 7.5% were fairly adequate and only 10% had adequate digital camera tools. This means that only 10% has an opportunity to exploit the benefits of the digital cameras in education while 90% will miss out. According to Krithika and Devi (2023), the benefits of digital cameras include instantaneous satisfaction, film produced is inexpensive, they have massive storage space for photos, they have multiple functions, images are easy to share, they are smaller and lighter, images are easy to edit, they have more display options, images can be printed from home or office, point and shoot technology is applied and lastly, they have a quicker operation than analogue cameras. The researcher identifies a research gap by the fact that only 10% have the digital cameras available adequately for use in biology teaching.

Al Husaeni et al. (2024) did a study whose results indicated that the digital camera did increase student learning of process skills in the two biology laboratory activities. The results of unpaired "t" tests for independent data indicated the differences were statistically significant for the process questions, while the differences in responses to the content questions were not significantly different. Anecdotal evidence also indicated that the experimental group took more interest in setting up the apparatus and made fewer mistakes in the lab procedure than did the control group.

The researcher also did a study on availability of computer laboratories in the sampled schools. From the study, majority of the respondents said that computer laboratory were inadequate in their schools as shown by a mean of 0.81 to 1.060 this could adversely affect teaching. In support of this, Ismail et al (2020) in their study notes that lack or inadequate ICT resources can seriously limit what the teachers can do in the classroom using computers. The results of this study confirm an earlier study done by Fomunyam (2019). on technological availability in schools in African. He affirmed that, African countries have

insufficient numbers of ICT resources and other related ICTs related resources and therefore limited use in the classroom. The results are also in congruence with the findings by Miima (2014) who found that secondary schools in Kakamega had no adequate ICT tools necessary for integration of ICT and this affected the integration of ICT in teaching Kiswahili.

The researcher investigated availability of video conferencing equipment in the sampled schools. According to Torrato et al. (2021), Video conferencing is connecting individuals and groups via telecommunication networks and video technologies in real time. The sound and images are transmitted electronically in a digital format, which provides simultaneous interactive communication. The data obtained from the current study shows that 66% of the schools did not had video conferencing equipments while 19% were inadequate, 8% were fairly adequate and only 7% had adequate. The study has shown inadequacy of video conferencing equipments. Several studies that have been conducted have shown the benefits of using video conferencing to teach. One of such studies is by Paderanga (2014) who states that video conferencing services tend to offer more than just face-to-face interactions. He notes that video conferencing services let users share their screens, remotely access one another's desktops, chat via text, exchange files, communicate via digital whiteboards, and even broadcast conferences to large groups of passive viewers.

In support, Torrato et al. (2021) did a study in Philippines and concludes that video conferencing (VC) has become an essential component in the world of education and many other fields. The study concludes that this method has given schools new ways of presenting materials, working with teachers and students; thus, stimulates the development of strategies that are consistent with new technology. From the current studies, it is evident that only 7% of schools are able to reap full benefits of video conferencing in biology teaching the learners. 93% of the schools have no video conferencing and therefore disadvantageous to a significant number of learners in Kiambu County. This seems to be the most inadequate ICT resource among those listed and investigated.

Research has revealed that public secondary schools in Kiambu County had inadequate ICT such as digital cameras, projectors, interactive whiteboard, computer laboratory, and video conferencing equipment which could be posing a big challenge in integration of ICT in biology teaching in public secondary schools. This a rich area for future research and a gap has been identified. Therefore, the teachers' most preferred ICT resources (or hardware) were desktop computers, while their most preferred ICT application (or software) was word processing using Microsoft Word.

The second objective sought to examine whether availability of ICT has any statistically significant influence on the integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya. To achieve the objective the following null hypothesis was formulated:

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H_{O1}: Availability of ICT resources has no statistically significant influence on the integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya

To ascertain the truth of the assumption in the null hypothesis, the Pearson correlation was carried out and the results are presented in Table 4

Table 4: Pearson Correlation for the Influence of Availability of ICT on Integration in Biology Teaching

Model Summary[b]

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.269[a]	.029	.021	.313	.029	3.852	1	131	.002	1.892

a. Predictors: (Constant), availability of ICT in school
b. Dependent Variable: ICT integration in biology teaching

From Table 4 the Pearson correlation coefficient between availability of ICT resources and integration in biology teaching in public secondary schools in Kiambu County was positive and significant (r = .269, p= .002). This means that any increase in availability of ICT resources leads to an increase in integration of ICT among teachers of biology in public secondary schools in Kiambu County, Kenya.

To ascertain whether the influence of availability of ICT resources on integration in biology teaching in public secondary schools in Kiambu county was statistically significant, simple regression analysis was done and the results are presented in Table 5

Table 5: The Simple Regression Analysis of the Availability of ICT and Integration Among Teachers of Biology in Public Secondary Schools in Kiambu County

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.813	1	.813	8.605	.002[b]
	Residual	12.382	131	.095		
	Total	13.195	132			

a. Dependent Variable: ICT integration in biology teaching
b. Predictors: (Constant), Availability of ICT

The results in Table 5 indicate that the F-value was significant F (1, 131) =8.605, p=.002). The null hypothesis is rejected. This means that availability of ICT resources has a statistically significant influence on the integration of ICT in biology teaching in public secondary schools in Kiambu County. Therefore, conclusion made is that availability of ICT resources made a significant contribution on the integration of ICT in biology teaching in public secondary schools in Kiambu county, Kenya.

The results were supported by other studies. For instance, a study by Muia (2021) on factors influencing the integration of ICT in teaching and learning in primary schools in Kitui-Central Sub-County from a sample of 90 teachers and 17 head teachers found that the availability of ICT resources had a statistically significant influence on teachers' ICT integration in teaching and learning in public primary schools in Kitui-Central Sub-County. This meant that most of the teachers who engaged in ICT integration came from schools with

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ICT resources. Similarly, Munje and Jita (2020) identified lack of software and lack of hardware as the main barriers for integrating ICT in pre-service teacher education programs. Buabeng – Andoh (2021) highlighted access to ICT infrastructure and resources in schools as a necessary condition to the integration of ICT in education. According to Zehra (2021) effective adoption and integration of ICT into teaching in schools depends mainly on the availability and accessibility of ICT resources such as hardware and software. Mogeni (2020) posits that obviously if ICT resources are not available in school, teachers can neither access nor use them for teaching. Therefore, availability of ICT resources such as computers, updated software and hardware are key elements to successful adoption and integration of ICT in teaching. Another study by Yildrim et al. (2022), found that access to technological resources is one of the effective ways to teachers' pedagogical use of ICT in teaching in Turkey.

According to Seifu (2020), access to computer and network both at school and at home is important for teachers. He found insufficient computers and low access to the internet as barriers to integration of ICT into teacher training. In support Abel et al. (2022), found that availability and access to hardware and software is not only important but also support teaching and learning. Hasin and Nasir (2021) observed that the availability of ICT in Malaysian secondary schools seriously limited what a teacher can do in the classroom with regards to integration. Far from Asia and Europe, Caskurlu et al. (2020) noted that teachers used computers for teaching since they were present in their places of work. In addition, they noted that American secondary schools have successfully integrated ICT in teaching mostly due to the availability of the computers. In support Shah (2022) did a study in Indonesian secondary schools and observed that teachers comfortably integrated ICT in teaching since computers are at their disposal. In addition, the study noted that teachers also use computers for their own work outside the school. Shah through his findings concluded that the main obstacle to technology integration in teaching worldwide is availability. Looking at availability of ICT and funds Hasin and Nasir (2021) states that many scholars proposed that the lack of funds to obtain the necessary hardware and software is one of the reasons why teachers do not use technology in their classes. A study on effects of availability of computers on integration in Saudi Arabia Universities, by Mahdi and Dera (2014), 78% of lecturers surveyed cited limited access to computers as a barrier to effectively integrating it computers in their classes. Of this, 38% thought inadequate computers were a great barrier to using technology in their classes. Therefore, efficient and effective use of technology by a large extent depends on the availability of hardware and software. Yildrim et al. (2022) in a study report revealed that over 50% of the respondents used computers for research and lesson preparation in their schools. About 78% of the respondents complained of inadequate access to computers in the classroom. Of this percentage, 38% of the respondents stated that inadequate computers were not great barriers to ICT use in their teaching, but improved availability and fairness of access to technology resources by teachers, students and administrative staff was essential.

Gikundi (2016) observes that though it is the government policy to integrate ICT in learning in public secondary schools in Kenya, there is no money factored in the Free Day Secondary Education Funds for ICT integration. In addition, he notes that, only a few schools have been given ICT facilities, but even with them no monitoring and evaluation has been done to ascertain ICT integration in teaching and learning. From the studies it can be agreed that availability of ICT has a significant influence on integration in teaching. This study

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therefore confirms what other studies have found that the availability of ICT has a statistically significant influence on integration of ICT in Biology teaching in public secondary schools in Kiambu County.

Summary of the findings

The results generated by the data analysis revealed that;

(I) The Pearson's correlation coefficient between availability of ICT resources and integration of ICT in biology teaching was positive and significant (r = .169, p= .002). This means that availability of ICT resources leads to an increase in integration of ICT among teachers of biology in public secondary schools in Kiambu county.

(II) The regression analysis indicate that the F-value was significant F (1, 131) =8.608, p=.002) This means that availability of ICT resources can predict integration among teachers of biology in public secondary schools.

(III) The null hypothesis ($H0_1$) was rejected and conclusion made that availability of ICT resources makes a significant contribution to integration of ICT in biology teaching in public secondary schools in Kiambu county, Kenya.

Conclusion

Based on the summary of the findings, it can be concluded that availability of ICT resources makes a significant contribution to integration of ICT in biology teaching in public secondary schools in Kiambu county, Kenya.

Recommendations

Public secondary schools should provide adequate ICT resources to teachers in order enhance integration in biology teaching.

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