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INFLUENCE OF INTEGRATION OF INFORMATION COMMUNICATION TECHNOLOGY ON PERFORMANCE IN CHEMISTRY AMONG PUBLIC SECONDARY SCHOOLS IN KISUMU COUNTY, KENYA

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ABSTRACT

The purpose of present research was establishing influence of Integrating Information Communication Technology (ICT) on performance in chemistry among public schools. The results showed a moderate significant positive correlation (at a confidence level of .05 where p=.05): r = .518, p=.033 in 2017, (p<.05, df = 1) between available ICT resources and software in teaching and learning and performance. Results further indicated a moderate positive correlation r = .560, p =.019 in 2017, between e-revision papers and performance; e-topical questions had a moderate positive correlation coefficient (p=.05): r = .610, P=.009 and r =.574, p = .016 respectively for the year of analysis; Internet access in schools correlated moderately r=.659, P=.004 in 2017. Regression analysis r^2 =.545 meant 54.4%, (p=.001, df = 1) of variation in mean grade could be explained by variation in use of Internet. It was concluded that ICT when well utilized has positive influence on education.

Key words: Influence, Integration, Information Communication Technology, Performance.

1. Introduction

Information Communication Technology (ICT) skills play a key role in promoting economic development of a country and its successful integration in schools to teach school subjects impacts on learning outcomes (UNESCO, 2003). Early research on new Information Technology for education indicated the need to integrate ICT into curriculum content as a teaching and learning tool. In Britain teaching using ICT started as early as September 1990 for primary and 1993 for secondary schools (Hawkridge, 2002). United Nations Human Development in the year 1999 called on all member states to develop and integrate national ICT strategies by middle 2001 (Bachelor, Evangelista, Hearn, Sugdem & Webb, 2005). During the same period regional initiative for Information Technologies came up with sectorial ICT strategies planning templates that saw Singapore develop a Master Plan for IT in Education (MPITE) initiated in 1997 to enhance linkages between schools and the surrounding world, and to generate innovative processes in Education and creative thinking (Grant, 2002). There is need for more recent investigations which may lead to new establishment of ICT in education; nonetheless, it is evident that worldwide ICT integration is embraced in schools to enhance teaching and learning activities.

The Philippines education department in 1996 initiated computerization program with the goal of preparing students for employment and competitive careers by encouraging them to master new forms of technology being used in teaching and learning (Camacho, Camacho & Basilica, 2012). The education experts intended to harness and enhance the power of technology towards developing the entire teaching-learning process. However, the researchers averred success stories were limited to teachers and administrators with ample access to digital infrastructure and ICT-open mindedness. The availability of ICT equipment in schools needs to be pegged on utilization to improve teaching and learning.

A research on more than 100 African schools by Karsenti, Collins and Harpen (2012), on pedagogical integration of ICT to improve the quality of teaching and learning, envisaged difficulty in effectiveness as statistics showed a ratio of more than 100 students to one computer in most

African countries. Success or challenges observed were due to Internet connectivity. Even the highest ranked schools had neither a website nor an e-mail address, mostly in the Republic of Congo and Central African Republic; where 7 out of 10 public schools had no Internet connections. Poorer still was Kenya and Uganda where 8 out of 10 public schools lacked Internet connections. Mozambique had the highest number of public schools with Internet connections in place, credited to existence of national ICT policy developed in 2000 with focus on education. By 2012 it had adopted School-Net as one of its flagship projects, with one quarter of the schools connected to the Internet. Perhaps other African countries can borrow from the Mozambique ICT policy in education in public schools to improve performance in such institutions.

Karsenti*et al.* (2012) investigated on a Pan African research Agenda aimed at understanding how pedagogical integration of ICT can improve the quality of teaching and learning in Africa. The researchers posited difficulty in the effectiveness of ICT into the learning process as statistics indicate more than 100 students for every computer in most public schools. The success and challenges in 350 plus public schools investigated using a sample of 100 public schools south of Sahara were identified as Internet connectivity; none of the computers at the schools were connected to the Internet. The research investigated pedagogical integration of ICT in a population of over a million public schools using a sample of only 100 schools and focused on lack of Internet. However, their sampling procedure was flawed for such a vast continent. Moreover, they failed to describe major flaws because they did not go further to determine the usage of other software programs in ICT-Teaching and learning processes in the schools.

In Uganda, the government has explicitly emphasized the importance of integrating ICT for teaching and learning, encouraged through its ICT incentives, policy formulation and various ICT projects being implemented according to United Nations Educational Scientific and Cultural Organization (UNESCO) declaration on current African education status and innovative ways for countries to support in achieving millennium goals (UNESCO, 2004). A report on Pan African Research Agenda on eleven educational institutions in Uganda highlighted one of the successes in the country's ICT integration in education as Cyber-Schooling Technology Solution in chemistry and other science subjects (Ndide, 2012). Students use the technology for undertaking practical work in a cyber (virtual world). This was observed in 3 out of the 11 institutions studied. It was evident that it enabled teachers to effectively teach science subjects. Most of the technologies were funded by the government or donor agencies because they proved to be expensive. Though cyber schooling and virtual world have not been introduced to Kenyan public secondary schools the former is a motivation for the current study which seeks to determine the influence of ICT integration on performance.

The Kenyan government policy on education in the year 1996 recognized ICT as key in promoting economic development of the country and development of ICT literate workforce was the foundation in which Kenya could acquire the status of a knowledge economy. The government then, through the Minister for Education directed all secondary schools to introduce computer studies in their curriculum (MOEST, 2005a) without explaining to the schools how they were to acquire the computers. In 2006 the government structured a national ICT policy document whose vision was to develop a prosperous ICT-driven Kenyan society, the mission of the policy was to

improve the livelihood of Kenyans by ensuring availability of accessible, efficient, reliable and affordable ICT services (Ministry of Education [MoE], 2006). The policy objectives in the education sector encouraged the integration of ICT in schools to improve the quality of teaching-learning and promote distance education, create awareness of ICT as an educational tool in the sector among others (MOE, 2006).

The ministry policy framework, according to Kenya country report (Ferrell, 2007) indicates that there are a number of challenges concerning access to and use of ICT in Kenya including high levels of poverty, limited rural electrification and frequent power disruptions. The paper continues to state that most secondary schools have some computer equipment but appreciates that however this could consist of one computer in the office of the school head. According to the document, even in schools that do have computers, the student-computer ratio is 150:1. This is not comparable to the situation in Britain where the learner-machine ratio was 8:1 in primary and 5:1 in secondary schools in the year 2006 (Education insight, 2006 cited in Ayere, 2009). The paper appreciates that most of the schools with ICT infrastructure have acquired it through initiatives supported by parents, the government, non-governmental organizations or other developmental agencies and the private sector, including the New Partnerships for Africa's Development (NEPAD) e-schools program.

The government of Kenya in the year 2011 under the Economic Stimulus Program (ESP) invested ICT equipment in 5 schools in every constituency in the republic in an effort to make education a platform for equipping the nation with ICT skills and objective to create a dynamic economic growth, enhance productivity, national and social development and reduce social inequality. Availing computers to the ESP schools was the first step by the government after NEPAD program of providing the equipment to public schools. The NEPAD program ended with the government coming up with the ICT concept as a national wide ICT program. This came in form of the ESP program whose objective was to support small, upcoming schools that lacked science equipment or basic science laboratories and libraries to supplement content delivery of Kenya Institute of Curriculum Development (KICD) software by using computers to display laboratory simulations and provide e-Libraries for such schools. Moreover, according to Kembouri, Lausnne and Nemaca (2009) ICT improves learning and facilitates faster coverage of program content; it allows sharing of information among learners who collaborate through community of learners. It also allows sharing of the few resource persons via research and dissemination of knowledge. ICT simulation was therefore identified by KICD as a stop laboratory measure that can be used to teach concepts and processes (KIE, 2007). The key objective was to expose learners to experiments through simulated laboratory experiences to familiarize with the apparatus and chemicals which they would otherwise just see for the first time during their final examinations.

With recommendations from District Education County Boards (DEB) the government funded five schools in each constituency in the republic with grants ranging from Kenya shillings (Ksh) 1 million to over Ksh 30 million per school for establishment of ICT centers, specifically for the purchase of computers and Uninterrupted Power Supply (UPS) units for each, printers, digital projector, networking, capacity building for all teachers in the schools and paid for Internet for 1 year; this would enable teachers to access Internet materials online (MoE, 2012).

The application of ICT for integration was effected on all subjects. Chemistry is one of the key subjects that would benefit greatly from Internet for example in laboratory applications and practical to demonstrate certain experiments. Integration of ICT by simulations was identified by KICD as laboratory measure that can be used to teach the scientific concepts and processes even in situations where the actual equipment and apparatus are lacking (KIE, 2007). The characteristic of chemistry that makes it characteristically based in ICT is that the experiments can be explained and demonstrated by animations and other ICT to make its abstract concepts easier. ESP schools lacked adequate laboratory equipment, but through simulations learners could be exposed to laboratory experiences. This way their performance in national examinations was expected to improve, but the performance has remained low for years. In order to determine the influence of pedagogical integration of ICT to improve teaching and learning there is need to carry out a study. Moreover, ICT integration when effectively done translates into improved performance, which has not been realized in Kisumu County, Kenya.

2. Research Methodology

This study targeted a population of 3,360 Form 4 chemistry students from 56 ESP public secondary schools with ICT centers in Kisumu County. The study also targeted 7 Sub-county Quality Assurance and Standards Officers (SQASO) one from each sub-county who are in charge of all ICT programs in their respective sub-counties. These are the informed experts in ICT who formed the specialist category of respondents. The consumer category of respondents included 112 chemistry teachers, 56 school principals and the 3,360 Form Four students in the ESP schools.

Simple random sampling technique was used to sample respondents from 17 secondary schools for the final study. A representative sample size of 340 form four chemistry students was used. Simple random sampling technique was used to select 39 chemistry teachers and 17 school principals. While, saturated sampling technique was used to select 6 SQASOs for the study.

2.1 Data Collecting Tools

The data collection instruments for this study were 4 questionnaires and an observation checklist. The instruments were the questionnaires administered to the School Principals, the Chemistry Teachers and Chemistry Students. In order to confirm the information gathered through the questionnaires and to establish practical extent of integration the researcher used the observation schedule. The fourth questionnaire was administered to the Sub-county Quality Assurance and Standards Officer (SQASO) in charge of ICT programs in each of the districts.

The quantitative data gathered to determine the influence of pedagogical integration of ICT on chemistry performance at KCSE was measured by correlation and regression analysis which was performed to test bivariate relationships among these variables on integration of ICT equipment and KCSE performance.

3. Findings

The objective of this study was to determine the influence of integration of ICT on chemistry performance at Kenya Certificate of Secondary Education (KCSE). Besides analysis on chemistry mean grades; the researcher also used the checklist to collect information on the trend of schools' KCSE chemistry mean grades for the period 2011 to 2017.

Performance Trends between 2011 and 2017 in Chemistry subject as examined in KCSE examinations were investigated and obtained through data collected using the observation checklist. For confidentiality and convenience the schools were coded using numbers from 1 to 17 and type identified only as mixed day for sub-county schools, county boys or girls schools, special school or national school for boys or girls. The results were presented in Table

Table 1: Performance Trends in ESP Schools from 2011 to 2017 in Chemistry at KCSE

Type of School	2011	2012	2013	2014	2015	2016	2017	Mean
1. Mixed day	2.835	2.625	2.500	2.470	4.137	2.592	3.304	2.923
2. Mixed day	3.490		3.410	3.360	4.010	3.720	3.920	3.652
3. Mixed day	2.770	2.670	4.086	3.240	3.420	4.330	5.744	3.751
4. County boys	8.721	6.261	6.618	7.066	8.209	7.782	7.645	7.472
5. County girls	3.493	3.524	4.157	4.761	4.363	4.045	5.104	4.207
6. Mixed special	3.375	3.500	3.110	3.419	2.838	2.980	3.720	3.277
7. National girls	7.218	6.278	6.946	7.605	8.209	7.463	8.585	7.472
8. County girls	3.310	4.190	4.320	4.458	4.893	4.160	4.500	4.262
9. County girls	3.481	3.375	3.187	3.659	5.000	3.821	6.500	4.146
10. County boys	5.534	4.619	5.403	5.615	6.391	6.391	6.379	5.762
11. Mixed day	2.558	2.800	3.255	4.706	4.501	2.649	2.813	3.326
12.County boys	6.424	6.425	6.416	5.484	6.662	5.775	5.802	6.141
13. County boys	5.210	4.661	5.300	5.860	6.520	5.290	5.283	5.446
14. National boys	9.397	9.266	8.375	8.680	10.247	9.819	9.899	9.383
15. Mixed day	3.430	3.130	3.383	4.155	4.798	3.961	4.365	3.889
16. County boys	2.770	3.670	4.086	3.240	3.420	4.330	5.744	3.894
17. Mixed day					5.255	4.197	4.016	3.367
Mean	4.354	3.940	4.385	4.575	5.463	4.90	5.489	4.845

Table 1 gives the trends of performance in sampled ESP schools from 2011 to 2017. The Table indicates that the trend in some of the schools lacked consistency as the mean grades in chemistry tended to fluctuate from as low as less than 3.5/12 for more than 10 sub- county schools in the year 2011. It is worthy to note that the ESP program started in 2012 hence immediate impact could not be expected; but the trend indicated for some of the schools was fluctuating improvements shown up to a maximum in 2015 (except for school number six, a special school) but dropped in 2016 and 2017 to give a mean of below 4.5/12 in sub-county schools. This is an exception of national school for boys with a mean of 9.383/12, and national school for girls with a mean of 7.472/12. Other schools that did not show much change in their chemistry mean grade over the years were extra-county schools for boys with a mean of 5.762/12, and 7.472/12 respectively. Others included a county school for boys with a mean of 6.141/12 and a county day school with a mean of 5.446/12. These are the schools whose mean grades remained more or less the same from 2011 to 2017.

A closer look at Table 1 reveals pockets of real improvements in various sub-county schools over the seven year period. For example, mixed secondary school number 3 started with a mean grade of 2.770/12 in 2011 and reached a high of 5.744/12 in 2017, registering a mean score of 3.751/12 for the seven year period. Another school that showed great improvement over the same period is county girls school number 5 that started with a mean of 3.493/12 in 2011 and rose to 5.104/12 in 2017 to register a mean score 4.207/12 in the seven year analysis; county girls school number 9 started with a mean grade of 3.481/12 in 2011 and rose to a high of 6.50/12 in 2017 and registering a mean of 4.14/12 for the seven years analysis. County girls' school number 8 started with a mean of 3.493/12 in 2011 to a high of 4.50/12 in 2017 and registered a mean score of 4.262/12 for the seven year period. County boys' school number 16 started with a mean of 2.77/12 in 2011 and rose to a high of 5.744 in 2017 registering a mean score of 3.894/12 in the seven year analysis. These schools showed significant change in in their mean grades and it could be safe to conclude that ICT integration could have played a significant role in the registered improved trends.

On the other hand in mixed secondary school number 17 there was no record of results until 2015 when their mean grade in chemistry was 5.253/12 which dropped to 4.016/12 in 2017 and registering a score of 3.367/12 for the three year period. Another school that showed weird trend was mixed day school number 11 that started from a low mean grade of 2.558 and rose to 4.706/12 in 2014 and 4.501/12 in 2015, but dropped to 2.183/12 in 2017 to register a mean score of 3.326/12 for the seven year analysis. It is difficult to explain factors that could have contributed to this trend. A similar trend was shown by mixed secondary school number 2 that started at 3.49/12 in 2011 and rising to 4.01/12 in 2015 but dropping to 3.92/12 in 2017 and recording a mean score of 3.652/12 for the seven years of analysis.

Mixed day school number 1 did not show a great improvement consistently starting from 2.835/12 and rising to 4.137/12 in 2015 and dropping to 2.592/12 in 2016 and rising again to 3.304/12 in 2017 registering a mean score of 2.923/12 in the seven year analysis. The only special school for the physically handicapped in the study showed a trend that was acceptable, starting from a mean of 3.375/12 in 2011 and registering a mean of 3.72/12 in 2017 and an overall mean score of 3.277/12 in the seven year period.

From the findings it is fair to conclude that learner achievements in KCSE chemistry in some ESP schools improved with time from the onset of implementation. ICT integration alone may not be the determining factor but other extraneous factors could have played a role in influencing improved performance in the identified schools. The mean performance in chemistry for the ESP schools for the seven year period was 4.845/12.

The research question in the current study dealt with the extent to which chemistry teachers use ICT educational software and resources in curriculum delivery and its influence on performance. This question was answered by analyzing the information gathered from the principals, chemistry teachers and chemistry students' questionnaires. The analysis in this area was done by considering available storage devices and their content, available equipment at the ICT center for teaching chemistry and digital content present in various storage devices. The principals and the chemistry teachers in the study schools were asked to state the type of digital content present in the storage devises that could be used for ICT integration during teaching and learning processes. Their responses were recorded and presented in Table 2.

Table 2 : Digital content present in storage devices

Digital content	Number of schools	Percentage
e-Revision questions	9	52.94
e-Past papers	4	23.53
e-Syllabus	8	47.06
e-Topical questions	9	52.94
Animations	4	23.53
e-Examinations	6	35.29
Teaching and learning materials	3	17.65
e-Schemes of work	1	5.88
e-Library materials	1	5.88
Internet accessed materials	1	5.88
e-Digital notes by KLB	1	5.88
Total	17	100.00

Table 2 gives a summary of digital content present in storage devises in the study schools. The Table shows that 52.94% of the schools had e-Revision questions as the digital content mostly preferred in their storage devises. These were majorly used by teachers to revise work covered in preparation for internal and external exams. The Table also showed that equally preferred were e-Topical questions that appeared as the other most important content stored in the schools storage

devises at 52.94%. These most probably served as resource for teachers to access major content for teaching their students. The next most commonly stored content in the schools storage devices was e-Syllabus in 47.06% of the schools. These were mainly used by teachers to develop their schemes of work and daily lesson plans. Examination papers were the next most popular digital content stored in the schools storage devices in 39.53% of the schools. Because in Kenya, performance is pegged on examinations mean grade, many teachers would prefer to access examinations materials readily in their local storage devices.

E-Past papers were popular storage device in 23.53% of the schools; these could be popular because many teachers believe that Kenya National Examinations Council (KNEC) bases set questions on past papers. Many high school teachers tend to drill their students on answering questions available in past Kenya Certificate of Secondary Education (KCSE) papers. Table 2 also indicates that only 23.53% of the study schools have invested in animations. These are videos that give activities and motion to chemical processes and reactions in order to make them appear simple to the learners. It is disheartening to note that only a few of the schools invested in this very important digital content.

Digital content on teaching and learning materials were found to be available in only 17.65% of the schools. These included teaching aid which in chemistry would include models to cover abstract topics like structure and bonding giving learners visual description of concept.

The least available digital content in storage devices in all the ESP schools included E-libraries, Internet accessed materials, e-digital notes by KLB and schemes of work all available in only 5.88% of the schools overall.

To explore possible implications of the observed mean grades, an analysis was performed to determine whether there was a correlation between availability of some ICT equipment for example the availability of communication systems (email, mobile phones) and the mean score at KCSE chemistry. This analysis involved computing Pearson Product Moment Correlation;

The researcher carried out further investigation of the school performance with the help of the checklist results to compare the schools KCSE mean grade to the usage of this ICT equipment in the study schools. The results were presented in Table 3.

Table 3 : Correlations of KCSE chemistry mean grade to communication systems

Year	Correlation	Communication systems: mobile phones, e-mail
2017	Pearson Correlation	.518**
	Sig. (2-tailed)	.033
	N	17

**correlation is significant at the 0.01 level (2 tailed), P=.05

Table 3 presents results of correlation analysis of KCSE mean grades to communication systems: e-mails and mobile phones available in the schools. The strength of linear relationship between the variables was measured by correlation coefficient which varies from 0 to -1 and from 0 to +1 (Dancey & Reidy, 2004). From the analysis the study established that there was a moderate

positive correlation between KCSE mean grade and communication systems: e-mails and mobile phones in the study schools. The correlation analysis statistics in Table 3 indicated a moderate positive correlation between communication systems: e-mail and mobile phones and KCSE mean grades (at a confidence level of .05 where alpha or$p$=.05): r = .518, p=.033 in 2017, (p<.05, df = 1) respectively. This confirmed that in places where teachers integrated communication systems in pedagogy they did more exposure and their students performed better. The findings also imply that when communication systems are used in teaching and learning, it influences academic performance in chemistry. This also means that when teachers integrate ICT during their lessons using communication systems, it is in congruence with academic achievement of their students which tend to be high.

In order to confirm if there was significant influence of the availability of the ICT equipment on the school mean grade a regression analysis was done on the two variables to measure how close the data are to the fitted regression line; this is also known as coefficient of multiple regression. The results were summarized in Table 4.

Table 4: Regression analysis on performance and communication systems

R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square change	F Change	Df1
.227[a]	.052	.012	.949	.052	.816	1

Table 4 presents a regression analysis on performance and communication systems: mobile phones and e-mails. The Table indicates that the value of r^2 =.052. This means that 5.2% of the variations in KCSE mean could be accounted for by the use of ICT resources and equipment. Table 4also indicates that the adjusted r^2 was only 1.2% showing that there were other characteristics and attributes in the variability that does not apply to the population.

Further analysis was done on a correlation between KCSE mean grade and digital content used in form of e-revision questions, e-past papers and e-syllabus. The results of this investigation were presented in Table 5.

Table 5 : Correlations of KCSE Mean Grade with e-revision papers, e-past papers and e-syllabus

Year	Correlation	e-revision questions	e-past papers	e-syllabus
2017	Pearson Correlation	.560	.251	.042
	Sig. (2-tailed)	.019	.331	.874
	N	17	17	17

**correlation is significant at the 0.01 level (2 tailed) P=.05

Table 5 presented the results of a correlation analysis of KCSE with e-revision papers, e-past papers and e-syllabus (p=.05). From the analysis the study established that there was a moderate positive correlation between e-revision papers and KCSE mean grade; the correlation analysis calculations in Table 5 indicate a moderate positive relationship r = .560, p =.019 in 2017, (p< .05, df =1). This was taken to mean that e-revision papers hence e-revision questions were utilized to impact on performance. The findings also indicate that when teachers direct their students to use e-revision questions to prepare for KCSE their achievement is contributed to significantly. This also means that when learners are exposed to revision questions that might be related to what is examined in KCSE then they are likely to achieve better.

Past papers in electronic form were also analyzed for a correlation with KCSE mean grade and the results were incongruent with the p values, their scores indicated a low positive relationship. The calculations in Table 5 indicated a weak relationship: r = .251, p=.331 in 2017, p>.05). This indicated that even if e-past papers were used to prepare students for their KCSE examinations their impact on performance was low; and this is confirmed by their probability values where p>.05. The statistics on Table 5 indicated that there was no correlation between e-syllabus digital content and KCSE mean grade; where the values of correlation coefficient were weak and incongruent as follows: r = .042, p= .874, p>.05, df=1).

Further analysis was done on a correlation between e-topical questions used by teachers during revision and KCSE and also animations used to illustrate abstract concepts to learners. The results of this investigation were presented in Table 6.

Table 6: Correlations of KCSE mean grade with e-topical questions and Animations

Year	Correlation	e-topical questions	Animations
2017	Pearson Correlation	.610	.574
	Sig. (2-tailed)	.009	.016
	N	17	17

**correlation is significant at the 0.01 level (2 tailed). P=.05

Table 6 indicated positive correlation between KCSE mean grade and use of e-topical questions and also use of animations. For topical questions and KCSE mean grade the correlation was moderate (p=.05): p= .018, r = .610, (p<.05, df=1) for the year of analysis. This confirmed that when teachers used e-topical revision questions to prepare their students for examinations it had a moderate impact on their KCSE results; this was confirmed by the probability values (p <.05)

Table 6 also shows that for schools where teachers and students used animations for illustrating concepts the correlation coefficient was moderate showing moderate correlation coefficient values: r =.574, p = .016) for the year of analysis; confirmed by the probability value (P<.05, df=1). This showed a moderate relationship between use of animations and performance of learners at KCSE.

Analysis was done to correlate KCSE mean grade to use of e-Libraries and Internet access using the checklist results and the results were presented in Table 7.

Table 7: Correlations of KCSE mean grade to e-Libraries and Internet:

Year	Correlation	e-Library	Internet access
2017	Pearson Correlation	.376	.659
	Sig. (2-tailed)	.137	.004
	N	17	17

**correlation is significant at the 0.01 level (2 tailed). *P*=.05

Table 7 presented the results of a correlation analysis of the KCSE mean grade with teaching and learning materials. The correlation analysis calculations in Table 7 indicated a weak correlation between e-Libraries that where utilized indicated a weak correlation with KCSE mean grade with incongruent scores: r =.376, p=.137, (p>.05, df=1) respectively for the year of analysis. This finding indicate that there was no relationship between e-Libraries usage in the schools and performance as confirmed by the p values (p>.05)

Table 7 also shows more interesting findings on analyses on the correlation between KCSE mean grade with access to Internet that indicated a moderate positive correlation between the two variables in 2017 From the analysis the study established that there was a moderate positive correlation between Internet access and KCSE mean grade: r=.659, p=.004(p<.05, df =1). This was confirmed by their probability values (p<.05) which further confirmed that whenever there is available Internet access in a school it impacts positively on performance.

In order to confirm the extent Internet access influenced performance in KCSE mean score a regression analysis was performed on the two variables and the results were summarized in Table 8.

Table 8: Regression analysis on Performance and of availability of Internet access

Change Statistics				
R Square Change	F Change	df1	df2	Sig. F Change
.545[a]	17.937	1	15	.001

Table 8 presents a regression analysis between performance and availability of Internet in the study schools. The results on the Table show that r^2 =.545 meaning that 54.4% , (p=.001, df = 1) of the variation in KCSE mean grade can be explained by variation in the use of Internet in teaching and learning, while the other 45.6% of the variation must be due to other factors as well. This is confirmed by the p value (p<.05).

4. Discussion

As was seen in the findings section, ICT integration when correctly utilized is likely to influence performance. This result is consistent with findings of Ikwuka and Angigwe (2017),
Colin, Lunzer, Tymms, Tylorand Restorick, (2004), Fauzi (2014), Nouh, Amer and Mostafa (2017), Forsyth and Jellicoe (2018), Becta (2005) and Moronder (2013).
Research on ICT integration indicate that when ICT are used as teaching and learning tools, they add value to teaching and learning process, similarly, related research indicate that ICT can extend learning and change delivery of content; moreover, it has been established that multimedia can be included in content to make it more appealing and capture learners' attention; the overall effect being an enhancement of students learning (Moronder, 2013). Related research on ICTintegration in chemistry confirms findings of positive correlation between students' visual-spatial abilities and their achievements in chemistry learning and problem solving (Becta, 2005)
As was seen in the findings section the performance of leaners in ESP schools that had benefitted from government grants for ICT centres improved over the seven year period. This finding is in line with the study by Wastiau, Blamire, Kearney, Quiattre and Monseur (2017) on the use of ICT in education during a survey of secondary schools in Europe that established that students who were taught with ICT had better academic performance with ICT instructional package, recommending use of ICT for teaching and learning in secondary schools. The current research opines ICT usage could have contributed to improved performance in some of the ESP schools, considering the time of inception through the period that the research covered, though it is possible that several other factors could have contributed to impact on the observed performance. Then, in explaining this finding which is consistent with the finding of research by Safdar, Yousuf, Parven and Benol (2011) that researched on effectiveness of ICT in teaching mathematics at secondary school level for private sector and established that ICT was found to be effective compared to traditional method of teaching; it can be pointed out here that when ICT are used as teaching and learning tools, they add value to the teaching and learning process; and have the capacity to support teaching, learning and classroom management as efficiency is increased.

As was seen in the findings section From Table 2 it was evident that none of the study schools had curriculum based software for teaching chemistry. This digital content was lacking completely and teachers relied on various revision materials to Integrate ICT in teaching and learning processes. According to African Virtual University (Onwu & Ngamo ,2013) e-Learning project on ICT integration in education-option chemistry, the materials and equipment required for the module include computer software and data logging equipment in chemistry, portable ICT devises for modeling and simulation, worksheet, spreadsheet, database templates and graph drawing software, web-based resources: for interacting with appropriate teaching and learning chemistry materials on CD-ROMs, websites and interactive multimedia display boards and word processing facilities. The current research findings indicate that the software that were available in the schools were not sufficient to support integration of ICT effectively in the study schools.

In describing ICT as a tool with immense potential to improve student learning outcomes and effectiveness if used properly, it can be also be mentioned that ICT provides immense learning and teaching opportunities which include great potential to increase learners motivation and help

students understand certain abstract concepts by making them clearer. In line, these descriptions agree with the findings of Ikwuka and Agingwe (2017) who researched on secondary school students' academic performance in Christian Religious Studies in Oshimili North Local Government area in Nigeria. Their study established that students who were taught with ICT had better academic performance with ICT instructional package, recommending that teachers should use ICT for teaching and learning.

Moreover, in explaining that ICT can have had positive impact on the performance of the schools with ICT, computerized molecular modeling in chemistry and ICT based laboratories have become tenable and can contribute great deal to students' achievements. This is in line with the study by Safdar*et al.* (2011) who researched on the effectiveness of ICT in teaching mathematics at secondary school level, and established that with large data sets, namely whole class effects are more significant determinants of performance more than individual effects, because in that particular study there was wide variation in use of ICT by children for school work at home. The study established higher mean gains corresponding to higher ICT usage, stating further that policy and practice of individual teachers, departments, and schools made significant contribution to the association between the level of ICT and examinations performance.

As was seen in the findings section the moderate correlation between communication systems to performance could be because of limited time and demand for equipment which requires availability of Internet; hence teachers did not use the computers at the ICT center for research purposes during preparation of their students for KCSE examinations, instead they could have used their telephones or laptops occasionally with projectors in the respective classrooms; otherwise the revision materials were printed and presented to students in hard copies or displayed via projectors to wider audience during revision. Teachers also claimed little control over the use of ICT center coupled with large class sizes and uncooperative school administration in availing Internet or scheduling the use of ICT center for subjects and class sessions.

This result is in line with the findings of a study by Nouh*et al.* (2017) who assessed correlation between students' perception of the learning environment and their academic performance in the form of grade point average (gpa) and found a low, yet positive correlation between perception about learning environment and academic performance. They indicated in their conclusion that improvement in the learning environment may enhance academic performance of students. The availability of communication systems in the present study could effectively enhance linkage between teachers for information that are shared. Availability of email also contributes to ability to research on different platforms hence increased confidence of the teachers concerned.

On the other hand the findings on the relationship between e-revision questions and performance of learner agree with the findings of Forsyth and Jellicoe (2018) who researched on predicting gainful e-Learning in higher education; established how student self-regulatory behaviors predict feedback engagements and behavioral change, indicating that measures of gainful learning by revision could be operationalized to suggest productive acquisition of beneficial skills, knowledge through study and experience. In the current study, when students engage in self or group directed revision by use of e-revision questions the experience acquired impacts on their performance.

Nonetheless, the studyfindings in this research is in line with the study by Colin, Lunzer, Tymms, Tylor and Restorick, J. (2004) who researched on the use of ICT and its relationship with performance in examinations and established a relationship using pupil-level, school-level and

multilevel modeling data. The study established higher mean gains corresponding to higher ICT usage. The current study views the moderate correlation between performance and e-topical questions and animations as a breakthrough from traditional pedagogical practices to ICT integration for the benefit of the learners in public schools in Kenya.

As was shown in the findings section, the variation in KCSE mean grade can be explained by variation in the use of Internet in teaching and learning. A study by Kou *et al.* (2014) established that learners had high confidence in gathering data or getting support through Internet, and both learner-learner and learner-instructor interactions were significant predictors of student performance. In Kenyan high schools Internet utilization is rarely by learner-learner interactions but learner-instructor or the teacher interactions pegged majorly on search for information or content.

The findings from a study by Fauzi (2014) are in agreement with the current study on the use of Internet for academic purposes among students in Malaysian institutions of higher education. The former study established that the duration spent on Internet for academic purposes was found to be significantly correlated with academic performance. According to Vetta and Getty (2018) who researched on the importance of Internet to education, the American government realizes the significance of Internet to its population's education and is actively making efforts to improve broadband network in rural areas with specific goal of aiding rural citizens' educational and professional opportunities. The national broadband project commenced in 2009 and is similar to other countries goals of making Internet access more attainable in order to improve education. In the present study Internet is considered important to education because it provides instant availability of vast stores of actual information in shortest possible time.

Current study sought to determine the influence of pedagogical use of ICT on chemistry performance. Pearson correlation coefficient test showed that there was a moderate but significant positive correlation (at a confidence level of .05 where alpha or p=.05): r = .518, p=.033 in 2017, (p<.05, df = 1) between extent of use of ICT software in teaching and learning and performance of learners from 2011 to 2017. Regression analysis the value of r^2 =.052confirmed that 5.2% of the variation in means scores in the study schools could be accounted for by extent of use of ICT equipment. Results further indicated that there was a moderate positive correlation r = .560, p =.019 in 2017, (p< .05, df =1)between e-revision papers that chemistry teachers used to prepare their students for examinations and their performance; e-topical questions used for revision by teachers and animations for explaining difficult concepts had a moderate positive correlation coefficient(p=.05): r = .610, P=.009 (p<.05, df=1) and r =.574, p = .016) respectively for the year of analysis; Internet access in certain schools correlated moderately r=.659, P=.004 in 2017, (p<.05, df =1). The results showed inregression analysis that r^2 =.545 meaning that 54.4%, (p=.001, df = 1) of the variation in KCSE mean grade could be explained by variation in the use of Internet in teaching and learning. It was concluded that ICT when well utilized has positive influence on education.

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