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Utilization Of Ict Teaching - Learning Resources And Its Effect On Student's Perfomance In Chemistry , Uasin Gishu County Kenya

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Abstract
Investing in Teaching-learning resources for chemistry in secondary schools should enhances the spirit of inquiry and right attitudes to handle scientific tools resulting to students' high academic performance. However, students' performance in chemistry has been dismal for several years. The objective of this study was to establish the relationship between utilization of Information Communication Technologies (ICT) and students' academic performance in Chemistry in Kesses Sub-County, Uasin Gishu County, Kenya. Education production function formed the theoretical basis for this study while Correlation research design was used. Questionnaires and document analysis were used to collect data. The target population was 43 school principals, 70 chemistry teachers and 2530 form three students while the sample units were 14 principals,14 chemistry teachers and 148 students. Data collected was analysed by the aid of Statistical Package for Social Science (SPSS – Version 26), where correlation and inferential tests was performed. Results of inferential tests from OLS regression model showed internet connectivity was positive and statistically significant at 0.670 (p< 0.001), suggests presence of internet connectivity enables usability of ICT facility for better understanding of chemistry. The study recommends investments by schools in internet connectivity.

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I. Introduction

Chemistry as an academic discipline plays a pivotal role in industrialization and hence, it is a catalytic component necessary for sustainable development and nation's growth (Igbonugo, 2014). Chemistry plays a huge role in the development of new knowledge which positively boost wealth creation, social welfare and international competitiveness (Awad, 2014). In regard to this the Kenyan government boost its relevance in country's development and economic growth, through the establishment of teaching and learning resources such as laboratories, science rooms, provision of laboratory resources in particular public secondary schools (Ministry of Education Science and Technology - MOEST, 2014) . Furthermore, professionals demand on industrial work which requires chemistry knowledge remains the government's main agenda thus, the utilization of ICT teaching-learning resources at secondary education level, which perhaps could lead to high performance in Kenya Certificate of Secondary Education (K.C.S.E), is a prerequisite.

The MOEST (2014) defined ICT as tools for enhancing knowledge conceptualization processes to particular discipline and learning opportunities, and information management. A study by Mirzajani, Mahmud, Ayub, and Wong, (2016) recommended in-depth study with a large sample on teacher acceptance of ICT and integration in the classroom for large scale generalization of the findings. Again, study by Ghavifekr and Rosdy (2015) on the effectiveness of ICT use in public schools recommended comparative study between public and private schools. Also, from the study of Buabeng-Andoh, (2019), while investigating inherent factors that influence teachers' pedagogical use of ICT in secondary school in Ghana, suggested a further study that aim at determining influencing factors on the utilization of ICT in specific discipline, with emphasis of using ICT facilities by knowledge providers and related performance. Based on the above knowledge backdrop in regard to ICT utilization, therefore, it warranted the need to undertake this study by establishing the relationship between the utilization of ICT and students' academic performance in chemistry

The Kenyan government has retrained science and mathematics teachers under the programme Strengthening of Mathematics and Science in Secondary Education (SMASSE) programme in secondary schools (MOE, 2005) and funds have been availed to schools through the free day Secondary Education (FDSE) to equip laboratories. However, from the KNEC report (2017) performance in sciences continues to be below average. Despite existence of strategies which have been put in place aimed at enhancing effective teaching of

science subjects in Kenya, however, metaphorical questions is 'Does the utilization of teaching-learning resources in the learning of Chemistry in secondary school have any significant effect on students' K.C.S.E academic performance?' still puzzles. Evidence of dismal performance in chemistry is depicted in KNEC DATA (2015-2019).

Nationally learners' average grade in the national examination chemistry results for the last five years averages 2.8 (33.3%) which is a mean grade of D. KNEC (2019). This is much lower than the National University entry which is a C+, a grade that is required for an individual to pursue a career course related to chemistry. This is a replica of sub-County of Kesses where the Chemistry K.C.S.E performance was low with a mean 32.02% which indicates a worrying trend to the education stakeholders of Uasin Gishu**.** This is blamed on the low usage of teaching-learning resources; The study therefore sought to establish the relationship between the utilization of ICT resources on students Chemistry academic performance .The study hypothesized that there is no statistically significant relationship between the utilization of ICT resources and students' academic performance in chemistry in Kesses sub-county.

II. Literature Review

Chemistry as part of science subject plays a critical role in technological advancement. This is because chemistry provides the economic basis of any industrializing nation including Kenya; therefore, emphasises in learning chemistry as subject at multi-facet educational level is essential (Burmeister *et al.,* 2012). As pointed out by Hofstein *et al.,* (2011) that science-based subjects more so chemistry remain to be a game changer in technology advancement in developing economies because conceptualized chemistry knowledge forms the foundation of every individual in a community. Human often interact with physiochemical and/or biochemical of living and inert while performing daily duties; hence, chemistry is life (Hofstein *et al.,* 2011). Kenya's vision 2030, which is portend with millennium development goals, views science subjects especially chemistry as enabler for the achievement of the industrialization as one of the pillars, (Riak, Mbugu, Tsuma, Ochuodho & Henry, 1996; Birgen, 2004).

Kenya's education system is organized, where summative evaluation of learners is done after four years in the case of secondary students. Evaluation allows learners to proceed for the few competitive positions in institutions of higher learning (Khatete, 1995). The qualifiers regardless of their economic challenges get subsidies as academic incentives from the government to pursue the courses of their qualifications in universities and training colleges (KNEC, 2017 & MOE, 2017).

Several studies have blamed underutilization of teaching-learning resources to stymieing students' chemistry performance in secondary schools and tertiary colleges (Mugure, 2012; Timms, *et al.,* 2006; Hassan, *et al.,* 2015 and Akani 2015). A study by Timms, Moyle, Weldon and Mitchell (2006) while assessing influence of teaching-learning resources on students' performance particularly STEM subjects in Australian schools, found that there was dismal performance on science literacy between 2006 and 2015. Again, study by Hassan, Ali, Salum, Kassim, Elmoge and Amour (2015) on factors influencing students' performance in chemistry in Zanzibar, found that there was lack of major facilities like laboratories and books. The findings suggest that underperformance in chemistry was associated with inadequacy of laboratory apparatus and reagents; hence, teachers were the only source of information in form of notes

Again, the study by Mugure, (2012), while assessing on impacts in the utilization of teaching-learning resource as perceived by knowledge suppliers in secondary schools in Mathioya District, Muranga County, Kenya. The study found that teaching-learning resources related to classroom instruction are adequate in the majority schools and are used well. However, computer rooms, labs, libraries, and science rooms are insufficient in majority of the schools. It was against this backdrop that a study was undertaken to find out the status of ICT facilities in Kesses Sub- County, Uasin Gishu County, Kenya.

Kenyan Ministry of Education (2012) defines ICT Integration as a means of integrating technology as supporting dissemination of knowledge aimed at improving learner's conceptualizing theoretical content and to meet curriculum objectives. According to Winzenried, *et al.,* (2010) contend that teachers who use ICT components in content delivery are efficient compared with ICT inexperienced counterparts. Most developing economies are aiming at using ICT facilities in knowledge delivery. For instance, in Kenya governments manifesto was to introduce one laptop per learner in order to enhance enthusiasm and technology advancement in learning, supporting the significance of ICT as teaching learning resources (Kozma & Vota, 2014).

Research by Kenya national authorities (2012) on ICT strategies in schools' which targeted the utilization of ICT facilities in teaching to enhance learners' understanding of curriculum objective and to foster inherent skills required in the use of technology in modern world. Hence, ICT remain to be input for optimal learning performance. In particular, when ICT is used in teaching chemistry it provides the learners with an opportunity to observe three dimensional molecules during the learning process Award (2014). Equally, study by Achimugu (2016) regarding senior secondary school chemistry teachers' perception on influencing factors in

the use of ICT in teaching chemistry in Kogi state, Nigeria, found lack of training and motivation among teachers, and inadequate funding affect optimal use of ICT components in teaching chemistry

Again, in the study by Belay, *et al.,* (2020) on the Availability of ICT resources for teaching and learning biology in secondary schools in the southern region, Eritrea, it revealed inadequacy of ICT resources like tablets, smart phones and internet in most schools. Similarly, study by Mavellas *et.al.,* (2015) on the availability, utilization and determination of factors that hinders its usage of ICT resources in teaching in secondary schools in Kwekwe, Zimbabwe, showed that most of the ICT facilities were unavailable and/or those with ICT resources were inadequate and poorly utilized. However, these studies (Belay, *et al.,* 2020 and Mavellas *et.al,* 2015) didn't link ICT resources with academic performance.

Perhaps, the unavailability and/or inadequacy of ICT components suggesting impedes effective use of ICT facilities (Ghulam, *et al.,* 2015). Necessary components that make ICT facility to be effective teaching/learning resource include; CDs, desktops computer space, internet, and laptops. Therefore, the unavailability of this resource indicates that ICT facilities in schools are ineffective (Ghulam, *et al.,* 2015). Other possible limiting factors to the use of ICT resources include literacy level on the use of ICT. Therefore, presence of ICT facilities with higher illiteracy of teachers on the use of ICT in content delivery remains equally as non-effective (Yang & Wang, 2012). As pointed out in the study of Ghavifekr, & Rosdy, (2015) who adopted descriptive survey research design between public and private schools while studying on effectiveness of ICT use in Malaysia, findings showed most respondents inclined to use ICT in teaching and learning. Reason cited on the inclination by respondents on the use of ICT was its effectiveness in teaching makes learning process to be more interesting and captivativating to the learners (Ghavifekr, & Rosdy, 2015). However, some countries like United Kingdom and Malta have realized effectiveness and acceptance by knowledge disseminators; thus, they have introduced support programs to enhance ICT to their teachers (Yang & Wang, 2012).

Furthermore, study by Mbugu, *et al.,* (2016) on the integration of Information Communication Technology in Teaching in Public Secondary Schools in Nakuru County, found that most schools had computers but lacked of other ICT accessories like white board and projectors were not available in all the schools. Furthermore, internet being the most useful facility in the integration of ICT was not available; hence, internet services provision was inexistence as opined by most school managers interviewed. In addition, the findings further revealed that very few teachers use ICT tools in teaching-learning process because majority lacked ICT skills.

Therefore, the study gap from the above cited research of the inability to identify the relationship between ICT use and academic performance, however, this study bridged that knowledge gap. Again, since this study was done in both public and private schools, it bridged research gap from the study of Mbugua *et.al,* (2016) which their research concentrated only on public schools.

III. Methodology

This study used Correlation Research Design in finding out the relationship between the ICT teaching - learning resource and student's Chemistry academic performance in Kesses Sub-County, Uasin Gishu County, Kenya.

The total numbers of secondary schools were 43 where 38 were public and the remaining 5 were privately owned. The students targeted in this study were all Form threes students with a population of 2530 who did chemistry together with their teachers in both 43 public and 5 private Kesses Sub Secondary schools in Kenya.

A sample of 30 percent was selected since it deemed adequate for a population of below 1000 (Mugenda & Mugenda, 2003). A proportion of 30% of 43 schools were 32 mixed public schools, 3 girls public boarding, 3 boys public boarding, 3 mixed private and 2 boys private in the study area was applied in selecting sample units giving a total 14 secondary schools.

Selection of students' respondents from form three class followed systematic simple random sampling procedure. where the class list of students was used in selecting students' respondents. That's, the first students from the list formed the reference points, while systematic pattern of choosing subsequent students was informed by the prorated number equivalent to 10% distribution to the class population giving a total sample of 148 students.

Furthermore 14 head teachers and 14 form three chemistry teachers were purposively selected from sampled secondary schools. Therefore, the sum of all respondents that were sampled to represent form three students, head teachers and chemistry teachers were 176 in this study. Both open and closed ended questionnaires and observation checklist were used were chosen as research tool for data collection.

IV. Results And Discussion

The purpose was to establish effect of the utilization of ICT teaching-learning resources on students' Chemistry academic performance in secondary schools in Kesses Sub-County Uasin Gishu County. The study hypothesized that there is no statistically significant relationship between the utilization of ICT resources and students' academic performance of Chemistry in secondary schools in Kesses Sub-County. The ICT variables included; adequate desktop, use of smart phones, frequency of ICT use in teaching, Internet connectivity and internet accessibility

Table 1 describes diverse perception from school managers, teachers and students in regard to the use and influence of learning resources such as ICT facilities on chemistry performance.

Table 1: Respondents' Perception on utilization of School Learning Resources

Variable		Attitude											
		Head Teachers				Teachers				Students			
ICT		**SD**	**D**	**A**	**SA**	**SD**	**D**	**A**	**SA**	**SD**	**D**	**A**	**SA**
Desktop	F	4	5	3	-	7	5	2	-	119	27	2	-
	%	33.3	41.7	25.5	-	50.0	35.7	14.3	-	80.4	18.2	1.4	-
Phones	F	4	5	3	-	4	3	4	3	89	42	13	4
	%	33.3	41.7	25.0	-	28.6	21.4	28.6	21.4	60.1	28.4	8.8	2.7
Accessories	F	3	5	4	-	4	5	2	3	88	44	13	2
	%	25.0	41.7	33.3	-	28.6	35.7	14.3	21.3	59.5	29.7	8.8	1.4
	%	41.7	25.0	25.0	8.3	42.9	21.4	28.6	7.1	61.5	20.3	12.2	5.4
Connectivity	F	5	4	3	-	12	2	-	-	119	24	2	3
	%	41.7	33.3	25.0	-	85.7	14.3	-	-	80.4	16.2	1.4	2.0
Power	F	1	-	5	6	-	-	8	6	-	-	-	-
	%	8.3	-	41.7	50.0	-	-	57.1	42.9	-	-	-	-

Source: Author. **Note: F** = represent frequency; **%** = represent percentages from frequencies from Likert Scale of Strongly Agree (SA), Disagree (D), Agree (A) and Strongly Agree (SA).

Chemistry being one of the core subject in most of the careers, it makes most schools to offer it as an examinable subject. In particular, School Principals, teachers and students perceived integration of ICT facilities in teaching chemistry was non-essential to performance based on Likert choices which inclined in disagreeing in influencing performance. Perhaps, inexistence and/or poor internet connectivity could remain an impediment in the utilization of ICT facilities as depicted by study results. This clearly shows that most of these facilities are almost unavailable in most school thus perceived to negatively influence the chemistry performance . This is in agreement with the study of Omotayo *et al*.(2020) where most ICT facilities were not available in most schools and the few which were available were not used frequently.

Table 2 shows the correlation tests results between the utilization of selected ICT resources that exists in schools and perceived to influence KCSE Chemistry performance.

Table 2: Relationship Tests Between Selected ICT facilities in Schools and KCSE Chemistry Performance

Variables	1	2	3	4	5
1. Adequate Desktops	1	0.166** (0.044)	0.186** (0.024)	0.275*** (0.001)	0.405*** (0.000)
2. Use of Smart Phones		1	0.257** (0.002)	0.197** (0.017)	0.076 (0.358)
3. Frequency of ICT use			1	0.324*** (0.000)	0.293*** (0.000)
4.Internet Connectivity				1	0.356*** (0.000)
5.Internet Accessibility					1

Source: Author; **Note:** Significant values (p-values) are in parenthesis; *p<0.1; **p<0.05; ***p<0.001.

Relationship tests between selected variables of ICT facilities showed to be positively correlated. However, their correlation coefficient values, which were below 0.5 reveals to be weak, suggesting that their purported relationship measure could mean different. Again, their level of their significance differs. That's majority of the selected variables showed to statistically correlated, implying that the selected resources of ICT was critical; hence, the variable were correctly identified and valid.

Inferential tests result to determine the level of influence of the selected variables of ICT resources on students KCSE chemistry performance was performed using OLS regression statistics as illustrated in Table 3 below.

Table 3: Results of Statistical Tests from the Selected ICT resources that Influences KCSE Chemistry Performance in Secondary Schools.

Variables.	(β_i)	(P_i)	S. E	t-test	Significance
Constant	2.071				
Adequate Desktops	-0.054	48.7%	0.239	-0.226	0.822
Use of Smart Phones	-0.072	48.2%	0.130	-0.559	0.577
Frequency of ICT Use	0.058	51.4%	0.153	0.379	0.706
Internet Connectivity	0.670	66.2%	0.119	5.605***	0.000
Internet Accessibility	-0.038	49.1%	0.190	-0.199	0.843
Error Term	1.000	73.1%	0.044	22.88	0.000
Adjusted R^2	0.187	-	-	-	-
F value	-	-	-	7.889***	0.000

Source: Author; **Note**: n=148; P(i) = Logit model values; S.E = Standard error; Significance level (p-values) are in parenthesis *** p< 0.001, ** p< 0.05 and * p< 0.1

Results of ANOVA tests, which profiles the level of goodness of fit in OLS regression model from selected ICT parameters estimators, revealed to be statistically significance at F = 7.889, (p< 0.000), indicating that there is no dependency among the identified variables in the model. While results of adjusted R square value, which explained 18.7% of the variation in the model, indicate that there exists critical variable of about 82% variation from the model which is out of the scope of this study. Therefore, the omitted variables in the models point out the need to bring on board other variables for determination of their effects in the model.

Regression tests results of internet connectivity in the school showed to be positive and statistically significant at 0.67 (p< 0.001) with probability to influence students' chemistry performance at 66.2% from maximum Log- likelihood model (logit model value), suggests that presence of internet connectivity was an ICT component that remain critical in influencing students' performance in chemistry.

Despite other variables depicting positive and statistically insignificantly, however, their direction of influence remains important on the need of integrating ICT resources in teaching chemistry for better students' performance. For instance, positive and statistical insignificance of frequently using ICT facilitates at 0.058 (p< 0.706) suggesting that when students are allowed to frequently use ICT resources could perhaps better students understanding on chemistry; and thus, better performance. Therefore, the government policy on digital learning is concomitant with this finding; hence, based on this study finding use of ICT is necessary and supported.

However, the result of inverse and statically insignificant of adequacy of desktops, use of smart phones and internet accessibility at -0.054 (p< 0.822), -0.072 (p< 0.577) and -0.038 (p< 0.843), and their probabilities of influence from log-likelihood statistics at 48.7%, 48.2% and 49.1%, respectively, imply that their presence of those variables and/or its use tend to impede students' performance in chemistry. For instance, inadequacy of desktops stymied the use of computers which could result into low students' performance in chemistry. Similarly, inexistence of internet connectivity makes low the use of ICT resources such as smart phones in teaching could result into low understanding and/or synthesis of chemistry concept among student; hence, end result could be poor performance in chemistry. Therefore, presences and use of ICT resources is critical if integrated in teaching chemistry for better performance.

Further from the result, the positive and statistical significance of stochastic variables at 1.00, (p<0.001) with probability to influence at 73.1%, suggests that omitted variables in the models are critical. Therefore, it points out the significance of unobserved and/or omitted variables in this study creating a knowledge gap. Hence, the need of further investigation on other factors that were beyond the scope of this study is necessary.

Findings from this study on the availability of ICT resources for teaching and learning Biology in secondary school was related to the study done by Belay, Khatete and Mugo (2020) in the Southern region of Eritrea. Their study revealed that inadequacy or absence of ICT resources such as smart phones, tablets and internets was unlikely to improve performance of the students. Again, study by Ghulam et al., (2015) pointed out that inadequacy of ICT teaching and learning components such as CDs, desktops and laptops hinders effective integration of ICT in teaching and learning process. Similarly, studies by Mavellas, Wellington and

Samuel (2015) on factors that hinders the use of ICT facilities in Secondary school in Kwekwe, Zimbabwe and study by Mbugu, Gori and Tanui (2016) on the integration of ICT in teaching in public schools in Nakuru, Kenya, supports the findings of this study.

Further the study tested the null hypothesis:

H_o: *There is no statistically significant relationship between the utilization of ICT resources and students' academic performance of chemistry.*

To investigate whether there exist any statistical significant relationship between the utilization of ICT resources and students' academic performance, the null hypothesis was tested using Pearson Correlation Coefficient analysis as shown in table 4.4

Table 4: Summary of Relationship Tests between ICT resources in Schools and KCSE Chemistry Performance

		ICT Facilities	Students Performance
ICT Facilities	Pearson Correlation	1	.464**
	Sig. (2-tailed)		.000
	N	146	146
Students Performance	Pearson Correlation	.464**	1
	Sig. (2-tailed)	.000	
	N	146	148

**. Correlation is significant at the 0.01 level (2-tailed).

The significance level (p-value) was below .05. hence, null hypothesis was rejected. Table 4shows results of correlation analysis between ICT resources and student's academic performance in chemistry.

The finding from hypothesis tests analysis in Table 4.6, shows existence of statistical significance positive correlation (r = .464, n = 146, p = .001) between the utilization of ICT resources and students' academic performance in chemistry. Since the relationship was statistically significant the hypothesis that "*There is no statistically significant relationship between the utilization of ICT resources and students' academic performance of chemistry"* was rejected. Therefore, it is logical to conclude that there is statistically significant relationship between the utilization of ICT resources and students' academic performance in chemistry. This study concurs with the study by Jonassen (2000) illustrates the use of ICT use by the learners provide the students with an opportunity to explore and experiment concepts in chemistry.

V. Conclusion

ICT resources which include lack of internet connectivity which hinders its accessibility, inadequate desktops and infrequent use of smart phones as depicted by study findings remain to be the bottlenecks in improving chemistry performance for the budding professional in chemical fields. Thus, the study concludes that the utilization of ICT facilities by teachers remains a critical tool in improving the performance of the students in chemistry. Emphasis should be laid on the internet connectivity for optimal usage by teachers and perhaps students for better students' performance in chemistry.

VI. Recommendations

This study therefore recommends resources mobilization by government and other stakeholders that include funding teaching and learning of ICT resources such as Internet connectivity and desktops because such facilities are inter-related as critical enabler for better chemistry performance in secondary schools as depicted by study results.

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