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TEACHER PREPAREDNESS IN THE PEDAGOGICAL INTEGRATION OFINFORMATION COMMUNICATION TECHNOLOGY (ICT) IN CHEMISTRY AMONG PUBLIC SECONDARY SCHOOLSIN KISUMU COUNTY, KENYA

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Abstract: *The purpose of present research was establishing the level of teacher preparedness in pedagogical integration of ICT among public secondary schools in Kenya. Results indicated that a mean of 9.7/39 teachers were computer literate and generally used ICT; confirming that computer literacy among chemistry teachers was low. Regarding the extent chemistry teachers used tasks with ICT in instruction, the study revealed that about one quarter of teachers have never used ICT at all, indicating that there has not been much success in ICT integration in Kenyan schools. Regarding capacity to use ICT by teachers in teaching and learning, almost half of the teachers have never used ICT, indicating that majority of teachers never integrate ICT inpedagogy. Nonetheless, there was significant association between teachers' extent of use of ICT and performance of their students. It was concluded that integration of ICT in pedagogy in chemistry was minimal.*

Keywords: ICT integration, Teacher preparedness, Pedagogical Integration, Performance.

1. Introduction

Several theories have been advanced to describe teacher training in Information Communication Technology (ICT) integration and its implementation in education. According to a report from UNESCO (2002) there is need to develop a resource text that addresses the inherent challenges of teaching teachers, how it should be planned and organized and technologies to be applied. A separate report from UNESCO (2013) on teacher training on ICT use in education, sought to establish informative inventory of professional development and teacher training programs on ICT integration focusing on ICT related curriculum courses. The objective was to synthesize topics of curricula for training teachers on ICT use in education; but failed to address the issue of content development that should be pegged to the environment of application for its relevance to the users. An earlier study by Fouts (2000) asserts familiarity with common software and other basic operations are important skills for teachers to possess.

Working on a curriculum for schools and program of teacher development, another report from UNESCO (2004) sought to offer support to educators in better ways of integrating ICT in the process of training and knowledge sharing in the field of education. The objective was to outline a professional development program to support teachers in implementation of ICT educational program for secondary school teaching that responds to current international trends. However it fails to address the issue of teacher training in institutional context, hence their capacity to use the technology in pedagogy. Harris (2002) researched on innovative pedagogical practices using ICT in schools in England and asserts that teachers are key intermediaries in the process of teaching and learning, as such 21st century teachers have to be confident, digitally competent and have the necessary ICT didactic skills. The former study links with the current on instructive nature of teaching using ICT. The researcher addresses the issue of constant interaction with equipment during implementation as an important ingredient to successful integration process. Researching on teacher professional development in the use of technology in the United States of America, Carlson and Gadio (2002) posit many countries now regard the mastering of the basic skills and concepts of ICT as an inevitable part of the core of education, while a report from UNESCO on teacher education guidelines illustrate effectiveness of integration of ICT applications in teaching however

depends to a large extent on teacher's familiarity and ability with the IT learning environment (UNESCO, 2002). These prepositions agree that mastering IT is a necessity, but overlook the core ingredient for integration, that is in-service training that goes further than basics normally considered elementary.

While researching on pedagogical principles and theories of ICT integration in chemistry at the African Virtual University in South Africa, educators Onwu and Ngamo (2016) and Ngamo (2006) assert teachers must also have certain competencies and abilities in order to support student learning with ICT. The studies link to the current one as skills entail competencies and abilities. However, they ignore the fact that prerequisite skill in the subject matter is also a useful ingredient in integration. According to the researchers ICT have become one of the fundamental building blocks of modern society. The study sought to develop teacher competencies and abilities common to all approaches in integrating ICT in learning as teachers seek ways to improve their teaching; including the ability to decide when, why, where and how ICT tools will contribute to ICT teaching objectives. The main objectives of the study were to help student teachers of chemistry in Africa to critically apply pedagogical principles of ICT integration in education and to integrate ICT appropriately into chemistry curriculum activities that will foster student ownership of their ICT-rich learning environment. They recommended that teachers should be able to identify key concepts in the process of ICT integration to critically engage in the required use of ICT based resources. The current study investigated the extent chemistry teachers apply ICT skills and their capacity to use ICT in pedagogy and, in the process, expose uncertainty to transit to ICT enhanced learning.

In June 2011 in order to jumpstart the integration process, the Kenyan government centrally trained 250 teachers designated as Economic Stimulus Project (ESP) champions (each drawn from a sub-county in the country) on ICT integration for one month. The ESP champions back in their respective sub-counties trained teachers in the schools that received grants for establishment of ICT centers. Over 25,000 teachers were trained countrywide on ICT integration to teach various subjects (RoK, 2013).

The national training of ESP champions took place once in the whole republic of Kenya, but how effective it was is the question that needs to be answered. The effectiveness can be measured by how well they articulated the training to the next level and the ICT skills possessed by teachers they trained, hence need for a study. The ESP champions at the constituency level in turn trained teachers at their stations on ICT integration. It is not clear whether it was a one-off training or if they were they mandated to continue training the teachers in the field. It is also not clear if the champions are still supporting and training teachers as they come into service. The question is do they have the capacity to do so even if they wanted to? At the ground are the trained teachers practicing ICT integration in chemistry instruction as expected? If not, why not? If so, why performance has remained low need to be investigated.

The perception of teachers as implementers of curriculum is important for the process of integration to be successful. The question that needs to be answered is do teachers perceive ICT integration as a process necessary to supplement their curriculum implementation process? It is not known why

performance has remained low consistently over the years and yet ICT integration is supposed to enhance the difficult and abstract topics in chemistry as a subject. It could be that the training the teachers underwent wasn't sufficient to equip them with the prerequisite skills to enable them adopt the technology in pedagogy. Could the problem be lying in the attitude of teachers towards the technology and possibility of unwillingness to adjust their roles in a changed environment and adopt the technology as part of curriculum delivery process? These are some of pertinent questions that need to be addressed.

The characteristic of chemistry is based on experiments and therefore highly amenable to ICT use and its abstract nature that makes it difficult for students to understand. The difficult concepts can be animated and made to appear simple to the understanding of the learners. The measures of effectiveness of ICT use would be reflected in the performance of the learners at examinations yet this is not being realized because the performance has remained low over the years. Could the problem be with the quality of the equipment or it's just a matter of the availability of time to integrate the technology that is missing on the part of the teachers concerned? For example when teaching a difficult topic, a follow up can be done using animations and other visual learning materials to enhance the leaner understanding of the difficult concepts. The main hurdles in learning chemistry and performing well in examinations according to a research by Atherton (2011) lies in students' inability to demonstrate a good understanding of very basic concepts of the subject. He recommended need for synchronization and integration of efforts including the use of ICT in part of the school. He noted further that there is a gap between what is intended in the national curriculum in terms of students learning in chemistry and what actually happens in the classroom where students learn chemistry. Current study aims to assess chemistry teachers' capacity to use ICT skills in a sample of ESP schools in Kisumu County, Kenya.

2. Research Methodology

The population studied in the current research comprised 3,360 Form four chemistry students from 56 Economic Stimulus Program (ESP) public secondary schools with ICT centers in Kisumu County, including 112 chemistry teachers7 District Quality Assurance and Standards Officers (DQASO). The sample included 340 Form four chemistry students, 39 chemistry teachers and 17 school principals. While, saturated sampling technique was used to select 6 DQASOs for the study. The demographic distribution of the respondents indicated a mean of 9.5 years of teaching experience, 3(8.33%) had post graduate degrees with Information Technology (IT), 15(41.67%) had undergraduate degrees with IT, 2(5.56%) had diploma certificates with IT, while 14(38.89%) had certificates in IT, while 11(31.43%) had not trained in IT at all.

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. One questionnaire was administered to the Chemistry Teachers and another to the School Principals. The third questionnaire was administered to Form Four 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 District Quality Assurance and Standards Officer in charge of ICT programs in each of the districts.

Responses on the extent of use of ICT equipment were coded using score values on the four point Likert scale as follows: Always with full capacity= 4, Sometimes with intermediate use = 3, Marginally with basic use = 2, Never = 1. Responses on the extent of use of educational software by chemistry teachers were also coded using five point Likert like scale as follows: Daily = 4, weekly = 3, fortnightly = 2, termly = 1, Not at all =0. Percentages of the responses on each item of Likert scale were then calculated and means and modes determined to denote extent of use.

3. Findings

Analysis was done in terms of teachers' ICT proficiency and the tasks that the teachers' were able to perform using ICT. The teachers' responses were analyzed on two different rating scales. In the first rating scale, the teachers' capacity was measured in terms of proficiency to use ICT tools, with Full Capacity being the measure of the most advanced proficiency level hence ability to use it always; Intermediate use being a measure of ability to sometimes perform practical tasks independently; while basic use measured the most basic level of proficiency of having functional understanding of computers and ability to marginally apply conventional software commands under direction. The rest of the teachers were rated as using Trial and Error or Not at all being able to use ICT. The teachers were asked to rate themselves on their ICT literacy and the extent they were able to use ICT in chemistry instruction. Their responses were analyzed and summarized in Table 1.

Table 1: Computer literacy among teachers in chemistry instruction

Extent of use	Always	Sometimes	Marginally	Never	Mean	Total
Number of teachers	2	17	10	10	9.75	39
Percentage	5.1	43.6	25.6	25.6		100

Table1 summarizes the extent of computer literacy among chemistry teachers. The Table indicates that 5.1% of chemistry teachers were computer literate and were capable of always applying the skills in instruction to full capacity. There were 43.6% of the teachers whose computer literacy were of intermediate use of the ICT skills and could sometimes apply the knowledge in instruction. The same table indicates that 25.6% of teachers had computer literacy with ability to marginally perform basic tasks with ICT in chemistry instruction. On the other hand a total of 25.6% of the teachers were computer illiterate hence were never capable of applying ICT in instruction. The mean of teachers who were computer literate were 9.75; confirming that computer literacy among chemistry teachers in the study schools was low in deed.

Training levels of teachers was measured in terms of duration of certificates of Information Technology (IT) held by teachers in addition to their professional qualifications: A degree certificate with computer studies, a diploma certificate with computer studies, and a certificate in IT that lasted up to two years or one year respectively. To explore on their ICT proficiency, the

teachers were further asked if they have had any training in IT that they could utilize in instruction during chemistry lessons, their Reponses were summarized in Table 2.

Table 2: ICT Training among chemistry teachers

ICT training among chemistry teachers	Number of teachers	Percentage
Bachelor of Education with computer studies	1	2.86
Diploma in education with computer studies	1	2.86
Up to 2 years certificate course in IT	13	37.14
Less than 1 year certificate course in IT	9	25.71
Not at all	11	31.43
Total	35	100

Table2 give a summary of types of ICT training among chemistry teachers. The Table indicates that a total of 68.57% of the teachers who responded to this question had basic IT skills, although, only one of the teachers of chemistry who had trained in bachelor of education did computer studies with their degree course, while another teacher who had trained in diploma in education did computer studies with their diploma course; There were 37.14% of teachers who had taken certificate courses in Information Technology (IT) that lasted up to two years in addition to their professional courses. Another 25.71% of teachers in the study schools had trained in IT by taking certificate courses of less than one year in addition to their professional courses. On the other hand 31.43% of the chemistry teachers in the study declared that they had not trained in IT at all.

In order to explore the specific ICT capacity of the chemistry teachers, it was important to inquire on the methods they applied in the usage of ICT in instruction and the extent they used such methods.To explore the specific ICT capacity of chemistry teachers they were asked to state the extent they used technology to perform tasks that included tasks to: navigate tutorials, browse by searching for tutorials, perform administrative duties like compiling marks, creating worksheets, creating talk books, use ICT in lesson preparation and perform functions like animating diagrams, building web animation, downloading images, drawing charts inserting videos and pictures in to existing documents in lesson preparation for chemistry instructions. Their responses were summarized in Table 3.

Table 3: Extent Chemistry Teachers use Tasks with ICT in Instruction

	Extent of usage: Percentage values				
Task (n=39)	Always	Sometimes	Marginally	Never	Total
Navigating tutorials	38.46	20.51	12.82	28.21	100
Searching tutorial	25.64	25.64	23.08	25.64	100
Administrative duties	17.9	51.4	12.8	17.9	100
Compiling marks	58.97	15.39	7.69	17.95	100
Creating work sheets	50.21	23.68	7.69	18.42	100
Creating talk book	5.13	25.64	25.64	43.59	100
Lesson preparation	12.8	12.8	46.2	28.2	100
Animating diagrams	5.13	30.77	30.77	33.33	100
Building web animation	5.13	30.77	30.77	33.33	100
Downloading images	15.38	30.77	25.64	28.21	100
Drawing charts	10.24	28.21	38.47	23.08	100
Inserting videos	10.24	28.21	38.47	23.08	100
Inserting pictures	10.53	18.42	36.84	34.21	100
Mean	20.44	26.32	25.91	27.32	

As can be seen in Table 3, teachers' mean tasks were computed on the extent of use of use of ICT. The Table indicates that a mean of 20.44% of teachers always used ICT to full capacity, while a mean of 26.32% of teachers sometimes used ICT with intermediate use, while a mean of 25.91% of teachers marginally used ICT with basic tasks, whereas 27.32% of teachers never used ICT at all.

In order to explore the chemistry teachers' capacity to use ICT in pedagogy, it was important to inquire the extent they were able to use various ICT skills in teaching and learning during instruction sessions of the subject and the results presented in Table 4.

Table 4: Teachers' capacity to use of ICT in teaching and learning

	Extent of usage: Percentage				
Task (n=39)	Always	Sometimes	Marginally	Never	Total
Teaching and learning	5.1	15.4	48.7	30.8	100
Use interactive white board	13.6	2.19	34.21	50.00	100
Conduct ICT class presentation	35.9	7.69	30.77	25.64	100
Conduct online class discussion	5.13	7.69	23.08	64.10	100
Create a quiz on PowerPoint	12.82	10.26	33.33	43.59	100
Use ICT to structure lesson notes	25.64	17.95	20.51	35.90	100
Teach students to write a report	2.56	20.52	38.46	38.46	100
Mean	14.39	11.67	32.73	41.21	

According to Table 4 the teachers mean tasks were computed and mean of extent of use established that a mean of 14.39% of teachers always used ICT in teaching and learning to full capacity, while a mean of 11.67% of the teachers sometimes used ICT in teaching and learning with intermediate use of ICT, and a mean of 32.73% of the teachers marginally used ICT in teaching and learning with basic tasks of ICT usage. On the other hand, a mean of 41.212% of the teachers never used ICT at all.

It was important to establish the extent teachers generally used ICT in their teaching-learning activities as presented in Table 5.

Table 5: General use of ICT by chemistry teachers

General ICT use	Number of teachers	Percentage	Valid Percent	Cumulative Percent
Always	11	28.2	28.2	28.2
Sometimes	9	23.1	23.1	51.3
Marginally	12	30.8	30.8	82.1
Never	7	17.9	17.9	100.0
Mean	9.75			
Total	39	100.0	100.0	

Table 5 gives a summary of teachers' general use of ICT and shows that in the general use of ICT by chemistry teachers 28.2% always used ICT to full capacity, while 23.1% of them sometimes perform intermediate use of the technology. The Table also shows that 30.8% of the teachers marginally possessed capacity to carry out basic tasks with ICT. On the other hand there were some 17.9% of the teachers who on general assessment were found to have never performed any task with ICT at all. The mean of teachers' extent of use of ICT was 9.75.

The researcher needed to statistically summarize measurement on the mean tasks and the percentage of the extent of use of ICT skills generally and in instruction by chemistry teachers. This was because it is from the knowledge on basic applications of ICT that one can apply the skill in general use and specific teaching and learning activities as shown in Table 6.

Table 6 : Teachers' mean tasks in the extent of ICT usage

Task with ICT	Teachers	Mean	SD	Percentage	Mode
Administration	39	2.65	1.329	30.8	2
Lesson preparation	39	3.51	1.167	23.1	4
Teaching-learning	39	3.72	1.213	28.2	4
General use	39	3.38	1.091	17.9	4

Table 6 gives a summary of teachers mean tasks in the extent of ICT usage, indicating that 30.8% of chemistry teachers who could use ICT in performing administrative tasks averaged to a mean of 2.65 which indicated those with capacity to perform basic tasks with ICT. The standard deviation for this task was 1.329. The highest mode scored on the rating scale by majority respondents was two which indicated the teachers sometimes used ICT by applying intermediate use of the equipment in administration. The Table also indicates that 23.1% of the chemistry teachers who could use ICT in lesson preparation scored a mean of 3.51 which indicated capacity to perform the task marginally. The standard deviation was 1.167. The mode indicated for this task was four which indicated that majority of the teachers scored to have never used ICT in the performance of lesson preparation tasks.

The same Table indicates that 28.2% of the teachers who could use ICT in teaching and learning averaged to a mean of 3.27 which indicated capacity to perform the task marginally. The standard deviation for this task was 1.213. The mode indicated for this task was four confirming that majority of teachers scored to have never used ICT or apply trial and error in usage of the equipment for teaching and learning processes at all.

All the respondents were then rated for generally using of ICT in their day to day activities and indicated that generally 17.9% of teachers who used ICT scored a mean of 3.38 which indicated capacity to use ICT marginally. The standard deviation for this task was 1.091. The mode was four, confirming that majority of teachers never used ICT. This finding indicates very low levels of ICT usage by teachers in the study schools.

A curriculum for schools and program for teacher development in the UNESCO (2004) report sought to offer support to educators in better ways of integrating ICT in the process of training and knowledge sharing in the field of education with an objective to outline professional development program to support teachers in the implementation of ICT educational program for secondary school teaching that responds to current international trends. In line with this district quality assurance officers were asked to give their expert opinion on the expected extent of use of ICT tools in a day to day teaching and learning activities. Their opinion was summarized as shown in Table 7.

Table 7: Expert opinion on expected extent of use ICT tools

Personnel	Basic Tasks	Intermediate Use	Full Capacity	Mean	SD
Administration	0	2	4	2.00	2.00
Teachers	2	2	2	2.00	0.00
ICT Staff	2	2	2	2.00	0.00
Learners	2	3	1	2.00	1.00

Table 7 gives a summary on the expected extent of use of ICT by administrators, teachers, ICT staff and students. The finding indicate that the MOE through the DQASO expected the school administration, teachers and ICT Staff to have intermediate to full capacity use of ICT Tools, with the learners expected to have just basic tasks and skills on use of ICT tools.

There was need to establish the extent that teachers' capacity to use ICT in instruction has affected performance, therefore a Chi-square (X^2)test was carried out to discover whether there was a significant relationship between teachers use of ICT and their learners' performance as shown in Table 8.

Table 8: Chi-Square for Influence of Teachers' ICT Capacity on Learners Performance at Kenya Certificate of Secondary Education

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	92.110[a]	42	.000
Likelihood Ratio	88.074	42	.000
Linear-by-Linear Association	.005	1	.946
N of Valid Cases	39		

a. 60 cells (100.0%) have expected count less than 5. The minimum expected count is .18.

Table 8 gives a summary of Chi-square for influence of teachers ICT capacity on learners' performance at Kenya Certificate of Secondary Education (KCSE). The Table shows that Pearson chi-square $X^2 = 92.11$, P=.001 degree of freedom df = 1. The results show that there is significant association between teachers' extent of use of ICT and performance of their students (P=0.001).

4. DISCUSSION

As was seen in the findings section, the extent chemistry teachers' use of ICT in chemistry instruction ranged from very low mode of always using ICT equipment with skills to full capacity to the highest mode of marginally or never using ICT at all. This has serious implications for the integration of ICT in teaching and learning the subject. It means that teachers implement ICT integration to varied degrees depending on their capacity but majorly never used the equipment at all; there is no unity in emphasis. This result is consistent with the findings of Marilyn and Norbert (2006), Rastogi and Malhotra (2013), Alazam, Baker and Hamza, (2012), UNESCO (2013).

Integration of ICT in teaching and learning is not a new phenomenon in education; as early as 2000 familiarity with common software such as Word, Excel, PowerPoint, Web animations, downloading images, drawing charts and tables, Inserting videos into PowerPoint, inserting pictures into an existing document and other basic operations were important skills for teachers to possess. Similarly, saving, and filing educational materials, compiling and organizing information have been important tools for a teacher to possess (Becta, 2005).The findings of current study confirm a weak response to the final report by the Ministry of Education (MOE) in Kenya on the re-alignment of the education sector to the constitution that teachers are expected to put a deliberate

effort to enhance their skills and capacity in the area of ICT integration (MOE, 2012). The statement went further to state that this would enhance the efficiency of the teachers in service delivery and also empower them to play their rightful role in the envisaged knowledge economy. So, considering that ICT integration when effectively done should translate to improved performance among learners teachers need to make every effort in the tendency to ICT literacy.

From the study it can be concluded that one-quarter of Kenyan teachers have not responded to the call of enhancing their ICT skills. According to the training approach, in the developed world programs of teacher development sought to offer support to educators in better ways of integrating ICT in the process of training and knowledge sharing in the field of education. The objective was to outline a professional development program to support teachers in implementation of ICT educational program for secondary school teaching that responds to current international trends in the fields of science (Burewicz & Miranowicz, 2006). The study recommended need for improvement in the planning and integration of ICT in education; commenting that the process of use of technology and integrating ICT in teaching enhances learning, enables interactive lessons and interesting classroom sessions which would in turn improve performance. Separately Chai, Ho and Tsai (2012) asserted the important ICT tools that a teacher should have include downloading, saving and filing educational materials; these skills are acquired through training in Information Technology (IT). So it is imperative that teachers should adopt IT training courses to improve their performance with ICT for the information age.

As was seen in the findings section there has not been much success in ICT integration in the schools. This finding is in line with a study by Rastogi and Malhotra (2013) who researched on skills and attitudes as determinants of ICT pedagogy integration and revealed that success of implementing curriculum with ICT in education depends greatly upon the attitudes of teachers and their willingness to embrace such technology and ICT knowledge and skills. Recommending that teachers should possess not only ICT knowledge and skills, but also have to develop and imbibe right attitudes towards ICT; because these have a marked influence in their readiness to utilize technology in their teaching. The results of their study suggested that teachers who were competent with ICT found it to be more useful, approached it with greater confidence and displayed low anxiety and aversion towards using it. current research opinions technology itself may not lead to change, rather, effort need to be made to develop favorable attitude amongst teachers in favor of ICT use in teaching and raising their competence level and proficiency in technological skills in order to exploit the potential of ICT meaningfully in teaching-learning process and to cause in turn, an effective integration of ICT with pedagogy to make schooling tangible and its impact long lasting.

Among global innovative pedagogical practices using ICT teachers are key intermediaries in the process of teaching and learning, as such 21st century teachers have to be confident, digitally competent and have the necessary ICT didactic skills (Hawkins, 2002). The former study links with the current on instructive nature of teaching using ICT. It is therefore important to address issues of constant interaction with equipment during implementation as an important ingredient to successful integration process. Similarly, researching on teacher professional development in the use of technology in the United States of America, Carlson and Gadio (2002) posit many countries now

regard the mastering of the basic skills and concepts of ICT as an inevitable part of the core of education, so teacher education guidelines should illustrate effectiveness of integration of ICT applications in teaching, but this however depends to a large extent on teacher's familiarity and ability with the IT learning environment.

The finding of the current study indicate that majority of teachers never used ICT in teaching and learning at all, yet discovering the scope of information available, for example, over the web and other ICT based cognitive tools and how to use it should be part of the changing role of undergraduate education of every chemistry student teacher. The fact that ICTs facilitate the world wide contacts between teachers and students is in the domain of governments worldwide. The Internet is now a veritable source of scientific data and theoretical information and offers a variable means to support authentic learning in chemistry (Onwu & Ngamo, 2004). The foregoing study links to the current in seeking to assess chemistry teachers' capacity to use ICT skills in chemistry instruction; moreover, there are challenges of uncertainty by teachers as asserted by Catalan (2007) while working on Problem Solving in Computer Aided Instruction in Science and Technology in Nigeria and concluded it is coupled with the change in the role of the teacher from an instructor to a constructor, facilitator, coach and creator of learning environments, a lot of research has been done to assess chemistry teachers' capacity to use ICT skills in teaching for this changing role.

The findings in the current research indicate that majority of Kenyan teachers never use ICT in pedagogy is in line with a study by Alazam*et al.* (2012) that revealed a significant correlation between ICT skills and ICT integration in classroom as majority of teachers never used ICT in teaching and learning in Malaysian schools. The current researcher opines the level of ICT usage is attributed to the skills teachers have. Therefore action needs to be taken to ensure that teachers have the skills needed for them to integrate ICT in teaching and learning.

As was seen in the findings section the mean of teachers' extent of use of ICT was 9.75/39. This is in contrast with a report from UNESCO (2002) that states that effectiveness of ICT an application in teaching depends to a large extent to teachers' familiarity and ability with IT learning environment. However, teachers should be able to identify key concepts in the process of ICT integration to critically engage in the required use of ICT based resources.

The findings in the current study are in contrast with report from UNESCO (2013) on ICT competency framework for teachers that encourage socially active classrooms, encouraging co-operative interactions, collaborative learning and group work. According to the report this requires a different set of classroom management. The current research concurs with the report on the use of new technologies in education by showing teachers mean tasks it also shows teachers capacities on the use of new technologies in education and implies new teacher roles, new pedagogies and new approaches to teacher education. The findings in Table 7 indicate that successful integration of ICT into the classroom depends on the ability of the teachers to structure learning environment in new ways to merge new technology with new pedagogy. An ideal ICT integration classroom activity according to Onwu and Ngamo (2004) requires the student knowledge of the subject matter, which is chemistry, and a measure of competence in chemistry-ICT integration skills. The teachers in turn should possess CDs or applets from various websites with series of tutorials and simulated

experiments available for a variety of chemistry topics, 3D visualization of molecular structure and generated computational chemistry exercises. The teacher is advised to first identify topics in chemistry suitable for integration and also try an ICT resource before using it with an aim of evaluating it by identifying its strengths and weaknesses and how it might support teaching aims in chemistry. The teacher then works out and displays the title and summary of the learning activity and gives a detailed description of the activity for example use of spread sheets before commencing with the activity with the students.

The current researcher recommends ICT as an effective tool when it is used by teachers and learners to interface with pieces of scientific equipment so that the required measurements can be made and data logged for later use. In an ICT learning environment, the central feature of practical activity in chemistry is usually observation and measurement, from which the learners collect data which they process and present in graphs automatically or in tabular form. The learners may be required to use their data or any other related data to make predictions about relationships between continuous variables and quantify such relationships. The experiences enable the learners' link chemistry with other curriculum areas like mathematics and numeracy. In conclusion learners may be made aware of the various uses of spread sheets in commerce, industry and daily tasks.

Alternatively a teacher may integrate a chemistry lesson by working with simulations and modeling for example when dealing with typically dangerous experiments. A good example is to simulate and experiment with an already solved problem (an existing scientific model) such as radioactivity decay, change in pH values or when learners have performed or have witnessed a demonstration; they can repeat the experience through modeling to give them further insight into the role of the variables and parameters in the process. Teachers are advised to limit their approaches to simple models even for complex processes. The minimum resource required by students to reproduce observed behavior, according to Onwu and Ngamo (2014) are a computer per student or group of students, modeling software or specific simulation program.

The perception of teachers as implementers of curriculum is therefore important for the process of integration to be successful. Moreover, the finding indicate that the MOE through the DQASO expected the school administration, teachers and ICT Staff to have intermediate to full capacity use of ICT Tools, with the learners expected to have just basic tasks and skills on use of ICT tools. Nonetheless, the government of Kenya has not addressed the issue of teacher training in institutional context, hence their capacity to use the technology in pedagogy. Whereas the Kenyan ICT policy is silent on the expected extent of use of ICT by teachers and administrators, a UNESCO (2013) report indicate a geographic divide on ICT education policy: while some countries are moving from ICT Education Master Plan (MP) 3 to MP4, most developing countries do not have a master plan in education at all, stating further low ownership caused by "outsourcing" and low implementation rate; whereby most developing countries do not have a recurrent budget for ICT in education and, finally, lack of monitoring on impact of ICT in education and learning outcomes. The current research opines on developing own standards by

developing countries, such that teacher education can design and provide training courses on ICT in education to overcome challenges.

Current study investigated chemistry teachers' preparedness in the integration of ICT in chemistry instruction. ICT integration in pedagogy among chemistry teachers in Kenyan schools is marginal. Results indicated that a mean of 9.7/39 teachers were computer literate and generally used ICT in their activities; confirming that computer literacy among chemistry teachers was low indeed. Regarding the extent chemistry teachers used tasks with ICT in instruction, the study revealed that about one quarter of teachers have never used ICT at all, indicating that there has not been much success in ICT integration in Kenyan schools. Regarding the capacity to use ICT by teachers in teaching and learning, almost half of the teachers have never used ICT at all, indicating that majority of teachers never used ICT inpedagogy. Nonetheless there was a significant association between teachers' extent of use of ICT and performance of their students.

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