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Benefits of Multimedia Computer Laboratories in Curriculum Delivery Kenya

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Abstract:
Having recognized the need for students to be skillful, creative and confident in the use of Computer Technology (CT), education stakeholders have employed various approaches to integrate it in teaching and learning. CT allows multimedia learning which has been found to be more effective than used chalk and talk that has been used over the years as the main delivery method. Research alludes that educators embrace new approaches only if they see how the new approach can help yield better results that the current one. Rogers's diffusion of innovation theory describes how an innovation goes through various stages before it is fully accepted. In order to improve the quality of teacher training, the Kenya government with assistance from Belgian Government has equipped public primary teacher training colleges (PPTTCs) with Multimedia Computer Laboratories (MCLs).This paper is based on a PhD thesis research that sought among other objectives to examine tutors' views about benefits of MCLs. The paper has a conceptual framework that shows the inter relatedness of various variables in multimedia learning. In order to get in depth and diverse information, the study used a descriptive survey design with a population of 845 tutors from PPTTCs selected from diverse geographical regions. The benefits of using the MCLs for instruction were found to be: access to online literature, increasing students' motivation and interest for learning, making work easier, and enhancing learning. The implication was that if MCLs are used adequately, they could improve the quality of instruction. The study recommended decentralisation of computers and their accessories from the MCLs to the classrooms.

Keywords: *Multimedia computer laboratories, computer technology, benefits and teacher training tutors*

1. Introduction

The importance of multimedia learning is underpinned on the principle advanced by Mayer (2005) in his cognitive theory of multimedia learning. He argues that people learn better when they see and hear than when they hear alone. A study on the use of life approach in the teaching of pastoral programs of instruction among teachers in Nairobi revealed that the practical approach of using various senses enabled the students to be attentive and grasp the biblical concepts easily (Nderitu,2011) In the MCL, instruction involves use of text, sounds, graphics, animations and videos which according to UNESCO (2013) promotes attentiveness, participation, understanding and retention among learners.

The worldwide use of CT in classroom instruction can be attributed to the numerous benefits arising from such integration. A survey of teachers' use of computers in six European countries, showed that a large number of participants was of the opinion that the use of computers and especially laptops was significant as it impacted positively on learning by promoting individual learning and enabling students to study after the timetabled hours (EU School net, 2010).

Positive impact of CT integration has been reported in developing countries as well. Buabeng (2012) did a survey of teachers' competences and attitudes in use of CT in Ghana and reported that CT improved learning by promoting learner-oriented instruction, critical and creative thinking. Similarly, findings of a study on classroom practices about use of CT in pre service teacher colleges in six Asian countries (Singapore, China, Korea, Thailand, Vietnam and Philippines) revealed that, the students benefited from diverse sources of subject matter and not just textbooks. The case studies found that CT had special effects that appealed to the senses of sight and hearing which in turn improved learning (UNESCO, 2013). Literature reveals advantages of using graphic presentations over the traditional methods that deal with real life situations. Van Joolingen and Veen, (2012) in a literature review highlighted practical reasons to use graphic presentations: safety cost and time. Other researchers have found that computers are a tool that makes work easier for the teacher (Hennessy, Harrison & Wamakote 2010, Tella, Toyobo, Adika, & Adeyinka, 2007 and Sime & Priesteley 2005).

The approach of using CT as a pedagogical tool for all subject areas is one of the objectives of introduction of the MCLs. For effective use, tutors were trained on how to use the MCLs to carry out curriculum implementation activities such as; internet search for subject matter, drawing schemes of work and lesson plans, presenting lessons using Avidanet software,

teaching using digital content and assessment using edumatic exercises (Republic of Kenya, 2010). The current study investigated the benefits utilizing the multimedia computer laboratories.

1.1. Significance of the study

The findings of this study may be useful to curriculum developers at the Kenya Institute for Curriculum Development (KICD) who are able get up to date information on how tutors perceive and use the MCLs. This information can help to engineer re-evaluation of capacity building in a bid to make tutors more effective in the use of the MCLs.

Quality Assurance and Standard Officers, and even the researcher herself as a curriculum specialist are expected to benefit from the findings of this study. Problems cited and recommendations made could help them to come up with different solutions that might help improve the perceptions and use of the MCLs.

Findings may be useful to the ruling Jubilee Government of Kenya which has one of its flagships being provision of laptops for learning to all Standard One pupils

in public primary schools to facilitate Digital Learning Program (DLP);

> ...Improve the quality of teaching and learning by working with international partners to provide solar powered lap-top computers equipped with relevant content for every school age child in Kenya. (Jubilee Manifesto, 2013: 26).

This study has given insight on the level of computer use preparedness of the primary school teachers. The study has shown gaps in the utilization of CT in PTTCs and suggested ways of addressing them. Issues and lessons raised in this study could be used by stakeholders to utilize CT in such a way that pre service teachers are able to emulate and use in their own classes in the primary schools as they implement DLP.

The research provided an opportunity to the tutors to express their views regarding utilization of the MCLs in teaching and learning. The interaction with the questionnaires and the researcher during the interviews could make tutors reexamine their approaches and attitudes towards the MCLs.

The study raises issues and challenges on CT use in PTTCs which might be a base for further research by other students and scholars interested in CT integration in education. The underlying factors hindering effective utilization of CT in PTTCs could be studied in more depth.

The published findings may also be of value to organizations such as the Televic NV of Belgium whose agenda is to assist developing countries by supplying and installing MCLs to facilitate application of CT in classroom instruction. The organizations are able to gauge the usefulness of their effort.

1.2. Limitations

The following were the limitations of the study;

Tutors' opinions and perceptions of the MCLS were assessed through self-reported assessment. That was a limitation because people have a tendency to be more sensitive when disclosing what they feel than what they know. A study of perceptions such as the current one is likely to encounter responses that may not be truthful or failure to respond at all to the questions by some respondents.

There was limited literature in the area of perceptions and use of CT in education in both Kenya and Africa in general, hence the researcher found it necessary to review much literature from sources outside Africa.

The opinions of student teachers and the teachers who have graduated would have enriched the study but it was not possible to cover them. Including them would have required considerable finances, time and other logistical resources which were beyond the reach of the researcher.

1.3. Delimitations

Integration of CT in teaching and learning in PTTCs is a wide subject. This study was limited to the investigation of tutors' perceptions and use of multimedia computer laboratories in six of the eighteen PTTCs in Kenya.

The study confined itself to tutors in public teacher training colleges which were the beneficiaries of the multimedia laboratories. Private teacher training colleges were excluded since they were not part of the MCLs project.

1.4. Assumptions

The study was conducted under the following assumptions:

All PTTCs were provided with MCLs for the purpose of integrating CT in teacher training. It was therefore assumed that CT was being applied in the learning process in public PTTCs and that indeed the laboratories were still in place.

Installation of multimedia computer laboratories in PTTCs was done on the basis that they would improve training of teachers. It was assumed that application of CT in teacher training would continue to be important in primary teacher education curriculum.

Innovations diffuse through a process whereby some teachers adopt and others fail to adopt the innovations. It was assumed that some tutors failed to adopt CT because they encountered challenges while applying CT in training of primary school teachers.

Multimedia Computer laboratories had a significant pedagogical role to play in education and that using the laboratories could and would result in better educational outcomes.

Some respondents might not respond truthfully for fear of being seen as unprofessional or weak based on their demography or being negative to MCLs and not using them while some might not answer at all. The researcher however assured them of confidentiality and anonymity and that the data collected would only be used for the purposes of research. Appropriate interventions could change tutors' perceptions and use of the MCLs leading to improvement in classroom practice.

1.5. Theoretical framework of the study

The study was guided by Rogers' (2003) "Diffusion of Innovations Theory" which explains how innovations diffuse among people. The theory explains why some people adopt an innovation while others do not. To adopt an innovation is to decide to make "full use of an innovation as the best course of action available" and to reject is a decision "not to adopt an innovation" (2003:176). The following are five steps that Rogers outlines with regard to diffusion of an innovation.

Rogers (2003) calls the first stage knowledge stage. This is the stage where the individual gets to know the presence of an innovation and tries to find out more about it. The next step, persuasion step, occurs when the individual has a negative or positive attitude toward the innovation, but "the formation of a favourable or unfavourable attitude toward an innovation does not always lead directly or indirectly to an adoption or rejection" (Rogers, 2003: 177). This is the stage where this study, as regards to the use of MCLs in PTTCs, found most tutors to be. Evidently, they had positive perceptions, yet they did not utilize the available CT resources fully in order to attain the desired results.

The next step according to Rogers (2003) is the decision stage where the individual chooses to adopt or reject the innovation. The decision stage is then followed by the implementation stage where an innovation is put into practice. Rogers indicates that the implementer may need technical assistance from change agents. He also says that reinvention may happen at the implementation stage where an innovation is changed or modified by a user. Rogers states that the more reinvention takes place, the more rapidly an innovation is adopted and becomes institutionalized. According to him, as innovations, computers are the tools that consist of many possible opportunities and applications, so computer technologies are more open to reinvention (Rogers, 2003). In this connection, the current study recommends decentralization of the computers and their accessories from the MCLs to the classrooms in order to optimize the benefits.

The final stage according to Rogers (2003) is the confirmation stage. This is the stage where the individual looks for support for his or her decision. This decision can be reversed if the individual is exposed to conflicting messages about the innovation. Depending on the support for adoption of the innovation and the attitude of the individual, later adoption or discontinuance happens during this stage. Discontinuance may occur if the individual rejects the innovation to adopt a better innovation to replace it or the individual rejects the innovation because he or she is not satisfied with its performance (Rogers, 2003). The current study has explored the factor of support in relation to perceptions and use of MCLS. Inadequate technical, administrative and policy support systems were found wanting hence hindering the benefits of the innovation.

Rogers (2003), describes the course by which innovations diffuse as a means of reducing uncertainty. He says that there are certain elements of an innovation that increase adoption of an innovation: relative advantage, compatibility, complexity, trialability, and observability. He further states that an individual's perceptions of these attributes predict the rate of adoption of innovations. He cautions that a new idea does not get accepted easily despite having recognizable benefits, so the usefulness of those elements of an innovation is catalysts of the course by which innovations diffuse.

Introduction of the multimedia computer laboratories in PTTCs is an innovation geared towards improving teaching and learning. However, individual tutors can either accept it or reject. Rogers' (2003) theory explains that accepting and adopting an innovation is a process characterized by various intervening variables. This study, therefore, found it crucial to examine factors that are related to perceptions and adoption or failure to adopt multimedia laboratory technology. A review of research studies indicates that physical factors including education policy, availability of computers, training of tutors in CT and support of tutors on computer use are critical factors towards realizing the benefits adoption of CT in training of teachers (Steketee, 2005; ChanLin, 2005; Hollow, 2009; Hennessey et al, 2010; Maruti, 2010; Wang'ang'a, 2012; Opati, 2013, khan; 2012 and Mwaniki, 2013).

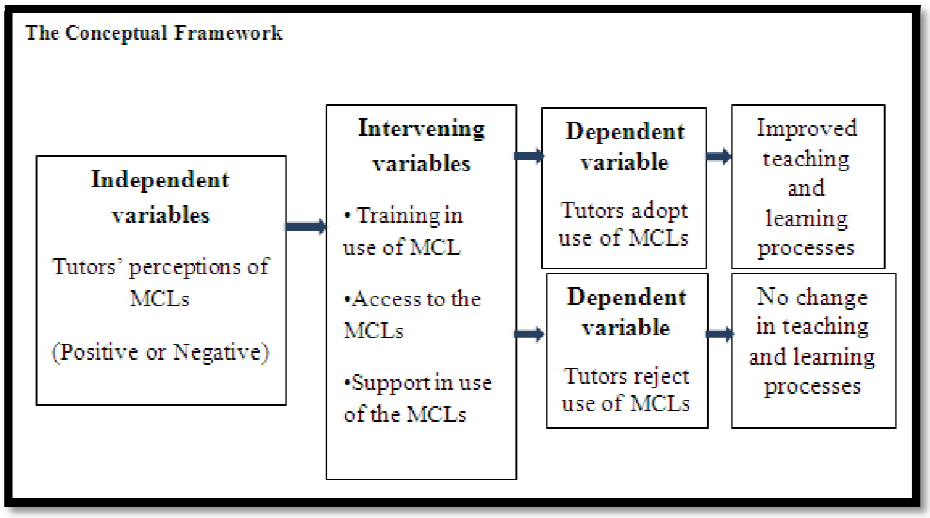

Figure 1: Own Conceptualized Relationship between Tutors' Perceptions, Use of MCLs and Intervening Variables

The conceptual framework illustrates the relationship of the research variables which are: the independent variable (tutors' perceptions of MCLs), the dependent variables (adopting or rejecting use of MCLs) and intervening variables (factors related to tutors' perceptions and use of the MCLs). Research has demonstrated that educational innovations are realized in the teachers' way of thinking before they become practice (Drenoyianni & Selwood, 1998). Yet, that way of thinking is influenced by external factors, referred to as intervening variables in the above conceptual framework. An individual tutor, who has a positive perception of the MCLs, will most likely adopt the use of the MCLs while the one whose perception is negative will reject. This argument is advanced by Rogers (2003) in his theory 'Diffusion of innovations' which states that a person who perceives an innovation positively will adopt it while the one who perceives negatively will reject. Literature review confirms the linkage between an individual's perceptions of CT and use. For example, Drent and Meelesen (2007) in Netherlands found that teacher educators who perceived CT positively used it for instruction while those who perceived it negatively did not use. Opati (2013) reported a similar linkage in study among teacher educators in Makerere University, Uganda.

The framework also shows that tutors' perceptions of MCLs are related to factors such as: training in CT, access to MCLs, and support in use of MCLs. When those factors are in place, adoption of the innovation will be realized but if they are lacking rejection is likely to occur. The implication, which is confirmed by this study, is that an individual tutor could have a positive perception of MCLs yet reject use due to the intervening variables.

Finally, the conceptual framework illustrates that when the MCLs have been adopted for instruction, the teaching and learning processes are improved. On the other hand, if the MCLs are rejected the teaching and learning processes remain unchanged.

2. Literature Review

Some studies on the use of CT in teaching and learning show that it improves learning outcomes. Hennessy et al (2010) found that application of CT in teaching and learning demonstrated indication of affirmative effects with regard to enhanced ability in reading, writing and number work numeracy and scientific skills among the learners.

In concurrence is Odera (2011) in a study on utilization of computers in secondary schools in Nyanza Province who reported improved learning outcomes as a result of heightened interest linked to learning with computers. Hollow and ICWE (2009) studied 147 e learning practitioners from 34 African countries and reported that introducing CT improved student attainment, and consequently increased value of education amongst the community. Grossman (2008) however, is critical and wonders if a method which is used only occasionally as in the case of computers has any impact on pupils' achievement.

It is expected that introduction of computer laboratories will enhance educational attainment in Kenya. The National ICT Policy points out that effort towards improving computer laboratories and empowering teachers with computer pedagogical skills are measures that can enhance remarkably educational outcomes at the PTTCs (Republic of Kenya, 2006).

Concerning the benefit of increased critical and creative thinking, (Jung, 2005) states that in Singapore, the foundation course called 'Instructional Technology' offered to teacher trainees encourages creativity through engagement in CT tasks including organization and management of learning experiences using appropriate computer resources. Zamfir (2008) proposes that the role of the teacher should be to ensure that learners are guided towards productive, reflective and creative learning using the CT tools with the aim of enhancing educational achievements. Literature reveals that use of CT in teaching and learning increases motivation which promotes student attainment. Zamfir (2008) in his study on the impact of computer applications noted that computer based learning (CBL) increases the students' motivation and interest for learning. Zamfir found that when students are motivated, they develop the skill of thinking critically and are able to solve different case studies for the 21st century society where computers have become an integral part of daily life.

Similarly, a research on teacher trainees' reflection on use of CT, reported that during an assessment of a Mathematics lesson "the children were very keen and seemed to enjoy" (Sime et al 2005:37). The researchers concluded that lessons in which CT was incorporated successfully in well thought out actions were observed as interesting and appealing to learners and therefore having higher possibilities of understanding and retaining knowledge. It is therefore important that tutors prepare the student teachers to enhance their lessons by employing CT to make them lively and motivating.

According to Hennessy (2010), computers are a tool that makes work easier for the teacher but the latter has to be crafty and adequately equipped to harness that. Sime et al (2005) gives an example of one classroom observed during their research where the computer was used quite a lot by one boy who had extreme difficult in writing things off the board. The boy typed and printed his work making it possible for him to keep up with the rest of the class. Similarly, Tella et al (2007) examined how secondary school teachers used CT and propositions for further progress of CT use in schools using a sample of 700 teachers and most teachers affirmed that CT is very useful and as makes instruction simpler.

The benefits of CT go beyond the apparent higher academic attainment to the economy of the wider society. In the foreword of the Trainer of Trainers Manual (Republic of Kenya, 2006), the then acting education permanent secretary recons that CT is a tool that is firmly embedded in modern society. Teachers are duty bound to embrace the technology which she claims can play a crucial role in transforming the country's development. The same view is captured by zamfir (2008) who says that it is apparent from research that using computer applications prepares students for the knowledge-based society and economy.

Many studies have therefore revealed positive effects of computer applications but Zamfir (2008) goes further to say that there is need for more advanced research aimed at improving and generalizing the effects of computer applications in education and eliminating the negative practices. He says that this could lead to better learning and teaching processes. The researcher hoped to expose some negative perceptions and computer practices which would need to be mitigated against in order to hopefully realize even higher student attainment.

Furthermore, literature review also shows that CT counters health side effects of real experiences. Van Joolingen and DeJong, (2008) in a literature review highlighted practical reasons to use graphic presentations. They highlighted safety because there are aspects of real experiments, which cannot be conducted safely in educational settings such as when studying the properties of radioactive material or viruses

3. Results

The fourth objective of the study, upon which this paper is based was to find out the tutors' views about the benefits of using the MCLs in teacher training. The question was an open ended one that was directed to the tutors who used the MCLs and required them to indicate the benefits of using the MCLs. Since this was an open ended question, tutors gave multiple responses. The researcher then grouped the responses into four groups: accessing online information, increasing student motivation, making work easier and enhancing learning. Following is a presentation, interpretation and discussion of each of the groups. The responses are also triangulated with responses of the interviews with the deans of curriculum. Figure 2 shows the responses on access to online information.

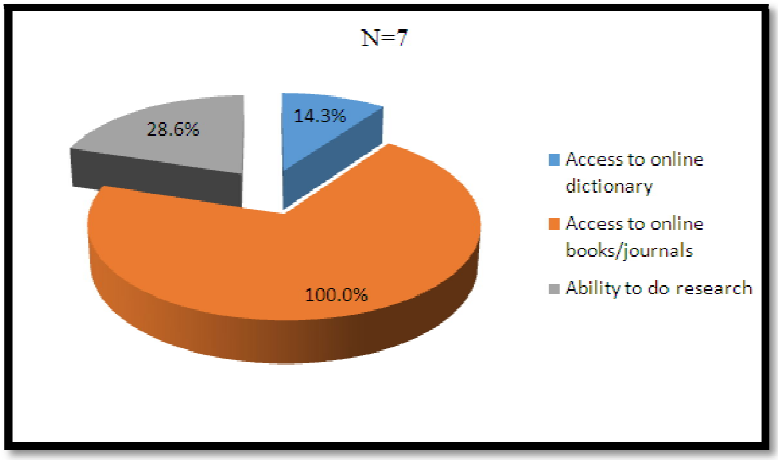

Figure 2: Tutors' Responses on MCLs Enabling Access to Online Tools

Figure 2indicates that in the group of access to online tools, access to online books/journal was mentioned by all the tutors who used the MCLs 7(100%). Other benefits that were mentioned in that category were ability to do research and access to online dictionary. The response about online information was also mentioned by the deans of curriculum in the interviews. One of the deans on being asked about the benefits of MCLs said;

> 'Since there is Wi-Fi in the lab, both tutors and students are able to access more and current information which enriches the content of their subjects.'

That response was in agreement with findings of other studies. UNESCO (2013) in a study of Edith Cowan University (Australia) reported that most pre-service teachers identified CT as an information tool that provided diverse source of easily accessible information for students to explore issues of interest to them. The implication of access to online information is that the MCLs have the capacity to improve the quality of the content in various subject areas since there is a wide and rich source of information available from the World Wide Web. Students do not need to rely solely on information in textbooks and from the teacher since the internet is providing alternative sources of information.

Another group of benefits that was mentioned was increasing students' motivation and interest in learning. The specific responses included: captivating presentations, interaction among students and interesting lessons. Figure 3 shows the results.

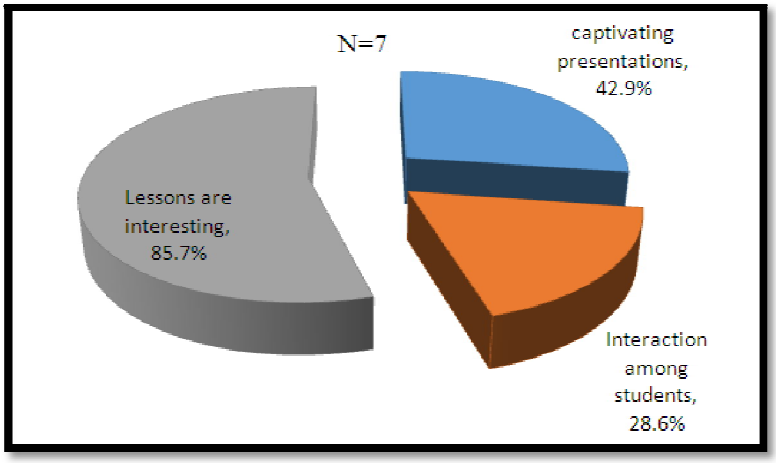

Figure 3: MCLs Increasing Student Motivation and Interest

Figure 3 indicates that in the group of responses on increasing student motivation and interest, majority of the tutors 5(85.7%) indicated that lessons done in the MCLs were interesting. Other responses in the group included MCLs enabling captivating presentations and enhancing interaction among students. In the interviews, one of the deans of curriculum said, "Students acquire basic skills in computer use and learning is interesting with high levels of understanding and retention."

The finding that computers increase students' motivation has been reported in other studies. Zamfir (2008) in his study on the impact of computer applications in Romania reported that computer based learning (CBL) increased the students' motivation and interest for learning. Similarly, Sime et al (2005), while assessing a mathematics lesson observed that the children were very keen and seemed to enjoy. The importance of increased student motivation and interest is enhancing students' attentiveness and engagement therefore improving effectiveness in learning.

Another group of benefits of using the MCLs that tutors highlighted was making work easier. The specific responses were: drawing accurate diagrams, promoting high retention, enabling retrieving and storing data, promoting sharing of information and making changes easily. Figure 4 shows the percentage frequency of the responses.

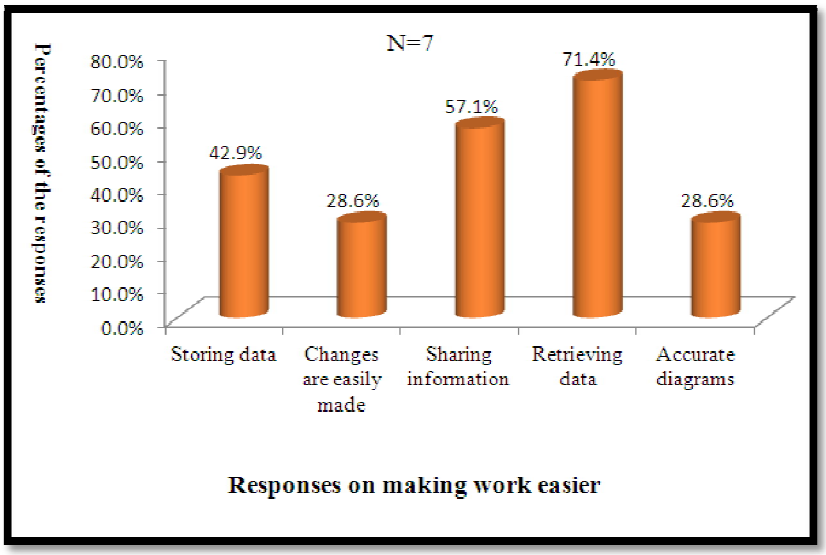

Figure 4: Tutors' Responses on the MCLs Making Work Easier

Figure 4 indicates that in the group of responses about MCLs making work easier, there was a variety of responses. Among the responses, the most frequently mentioned 5 (71.4%) was retrieving data followed by sharing of information 4 (57.1%). Other benefits in this category that were less frequently mentioned were storing data, drawing accurate diagrams, and making changes easily. With regard to benefits, one dean of curriculum during the interview said, "....processes like generation of electricity can be seen without having to make costly, tiring and sometimes dangerous trips. When students see the graphics and discuss among themselves as they watch, concepts become clear."

Literature reveals advantages of using graphic presentations over the traditional methods that deal with real life situations. Van Joolingen and DeJong, (2008) in a literature review highlighted practical reasons to use graphic presentations: safety cost and time. Other researchers have found that computers are a tool that makes work easier for the teacher (Hennessy et al 2010, Tella et al 2007 and Sime et al 2005).The implication of the MCLs making work easier is that using the MCLS facilitates efficient use of time and material resource which in turn improves effectiveness in syllabus coverage.

The final group of benefits was about CT enhancing learning. The specific responses were promoting better understanding and high retention of what is learnt. Figure 5 shows the results.

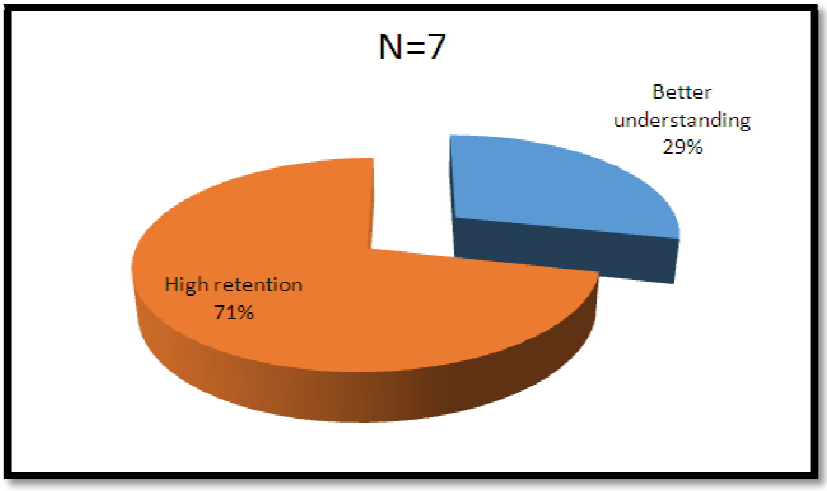

Figure 5: Tutors' Responses on How Use of MCLs' Enhances Learning

Figure 5 indicates that one of the benefits of using the MCLS is enhancing learning. The most frequently mentioned response in that category 5(71.4%) was high retention of material that is learnt while a few 2(28.6%) mentioned that MCLs promoted better understanding. The benefit of MCLs enhancing learning is in agreement with other studies. Hennessy et al (2010) found that application of CT in teaching and learning demonstrated evidence of positive outcomes in terms of improved literacy, numeracy and science learning by students. Similarly, Hollow et al (2009) in a survey of 147 e learning practitioners from 34 countries in Africa reported that introducing CT improved student attainment, and increased value of education amongst the community. Further, having been trained using CT it is assumed that the graduating student teachers would use it in their own classes. This could assist the current Jubilee Government that is implementing Digital Learning Program (DLP) in primary schools across the country. During the 5th international conference on TVET at the Rift Valley Technical Training Institute, the then Cabinet Secretary, Dr. Fred Matiang'i said,

> The rolling out of DLP will bring about a change from the traditional classroom chalk and talk approaches to the state of the art Smart classroom. This initiative will change the shape, function and structure of education .... (Kaluoch, May 2016).

6. Conclusion

Further, the study concluded that though the MCLs were minimally used by specific subject tutors, computers and other accessories in the MCLs were perceived to be beneficial in teaching and learning in various ways. The implication is that if the MCLs were used appropriately, the quality of instruction in PTTCs would be improved.

7. Recommendations

The study found one of the benefits of using MCLs as ability to use online literature but has not been effectively done. The study thus recommends that PTTCs be more proactive in improving the quality of subject matter by tapping from the global arena. Students can benefit more if they were given topics to research on or projects to do and share with the others via blogs or even social media. Colleges should have web pages where tutors can post and share important academic information. Colleges should also subscribe good quality online scholarly books and journal articles instead of just relying on course books that they have used over the years as reported.

8. References

i. Buabeng, C. (2012), an exploration of teachers' skills, perceptions and practices of ICT in teaching and learning in the Ghanaian Second-Cycle Schools. Andoh Pentecost University College, Ghana contemporary educational technology vol.3 (1), 36-49
ii. ChanLin, L. J. (2005). Development of a questionnaire for determining the factors in technology integration among teachers. Journal of instructional psychology.pg 287.
iii. Drenoyianni, H., & Selwood, I.D. (1998). Conceptions or misconceptions?Primary teachers, perceptions and the use of computers in the classroom, UK. Journal of Information and Technologies, vol 3, pp. 87-99.
iv. Drent, M., & Meelissen, M. (2008). Which factors obstruct or stimulate teachereducators to use ICT innovatively? Journal of computers and education, vol.51, (1), pp. 187-199.
v. EU School net. (2010). Summary: Net book pre-pilot evaluation for teachers. Available at: http://www.eun.org/web.
vi. Grossman. S. (2008), Supplementing textbooks with computer based resources inthe primary EFL-classroom, Padagogishe Hochschule Freiburg Master studie gang Didaktik des Fruhen Fremdsprachenlernens, Freiburg 1 Br.
vii. Hennessey, S. Harrison, D., & Wamakote, L. (2010). Teacher factors influencing classroom use of ICT in Sub-Saharan Africa.Itupale online journal of African studies, vol. 2 pp. 39- 54.
viii. Hollow, D. & ICWE, (2009). E-Learning in Africa: Challenges, Priorities and Future Direction. Retrieved on from http://www.ncrel.org/cw/ Captured Wisdom'.
ix. Jung I.S. (2005) ICT-Pedagogy integration in teacher training: application casesworldwide, journal of educational technology and society, vol 8, (2), pp.94-101.
x. Khan, S.H. (2012). Barriers to the introduction of ICT into education indeveloping countries: the example of Bangladesh. International Journal of Instruction July 2012 . Vol.5, No.2e-ISSN: 1308-1470 . www.e-iji.net p-ISSN: 1694-609X
xi. Maruti, S.J. (2010).E-learning readiness among public primary teacher training colleges in Kenya. Department of Management, Policy and Curriculum Studies, Med. Theses Kenyatta University, Nairobi, Kenya.
xii. Mayer R.E. (2005).The Cambridge handbook for Multimedia learning.Cambridge University Press.
xiii. Mwaniki, M.S. (2013). Responsiveness of primary teacher education in kenya to challenges of the 21st century. Unpublished PhD Thesis. Kenyatta University NCTE (National Council for Teacher Education) (2009). National Curriculum Framework for Teacher Education. From: http://www.indg.in/primary-education/teacherscorner/national_curriculum-for-teacher-education.
xiv. Nderitu M.W. (2011).Application of Life Approach in the teaching of Catholic Programs of Pastoral Instruction in Primary schools in Kasarani. M.ED Project, Kenyatta University. lap Lambert Academic Publishing.
xv. Odera F.W. (2011). A comparison of the use of Computers by Secondary School Teachers in Kenya, M. ed Theses Bondo University College: International Journal of Science and Technology.
xvi. Opati O.D. (2013).The Use of ICT in Teaching and Learning at Makerere University The Case of College of Education and External Studies. Makerere University, Kampala, Uganda.
xvii. Republic of Kenya. (2006), National ICT Policy. Government Printer, Nairobi.
xviii. Republic of Kenya, (2010). Installation of multimedia laboratories for schools in Kenya: Trainer of Trainers manual. Government PrinterNairobi.
xix. Republic of Kenya, (2012), Sessional Paper No. 14 of 2012: Policy Framework for Education and Training, Government Printer, Nairobi.
xx. Rogers, E.M (2003). Diffusion of Innovations (4th ed.), New York: The Free Press.
xxi. Sime, D and Priesteley, M. (2005), Student teachers' first reflections on information and communication technology and classroom learning: implications for initial teacher education. Journal of Computer Assisted Learning.
xxii. Steketee, C. (2005). Integrating ICT as an integral teaching and learning too into pre-service teacher training courses. Issues in Educational Research, Vol 15, pg.1-10.
xxiii. Tella, A., Toyobo, O.M., Adika, L.O. & Adeyinka, A.A. (2007). An Assessment of ICT's Use in Nigerian Secondary Schools. School Teachers' Use of ICTs: Implications for Further Development. The Turkish Online Journal of Educational Technology, 6(3), 12.
xxiv. UNESCO (2013).Integrating ICT into Teacher Education Curriculum in Asia, Published by UNESCO Bangkok Asia and Pacific Regional Bureau for Education Mom Luang Pin Malakul Centenary Building 920Sukhumvit Road, Prakanong, Klongtoey Bangkok 10110, Thailand.
xxv. Wang'ang'a G. (2012). A Framework for Integrating ICT in the Teaching and Learning Process in Primary Teacher Training Colleges in Kenya, UniversityofNairobi,http://erepository.uonbi.ac.ke:8080/×mlui/handle/123456789/6824.
xxvi. Zamfir A. (2008). Impact of Using Computer Applications in Education on Teaching-Learning Process Faculty of Management Academy of Economic Studies Bucharest6, Piata Romana, RO 030173, Bucharest Romania.