International Research Journal of Management and Social Sciences
Volume (1) Issue (7) Year (2016)
ISSN: 2455-4553

AUGMENTED INSTRUCTIONAL ROLE OF THE TEACHER AND LEARNERS CHARACTERISTICS IN COMPUTER ASSISTED SCIENCE LESSONS AMONG SECONDARY SCHOOLS IN KENYA

Samuel N. Jesse[A*], John N. Maundu[B], Nicholas W. Twoli[B]

[A]Kenya Institute of Curriculum Development
[B]Kenyatta University

ABSTRACT

Teacher-centered instructional methods where learners are placed in a passive role is undesirable, yet such is the norm in the majority of classrooms in Kenya. The teaching technique that a teacher adopts may affect learners' performance and therefore applying an appropriate teaching method is critical to the successful science instructional process. The study reported in this paper sought to investigate the influence of instructional methods on the role of the teacher and learners' characteristics in science lessons. Biology, Chemistry and Physics (Science) teachers and Form Two learners from six secondary schools situated in Embu County in Kenya were involved in the research. The Form Two classes in three of the six secondary schools were randomly assigned group one while the Form Two classes in the remaining three schools were assigned group two. Group one was taught through computer assisted instruction (CAI) while in group two, conventional instructional methods (CIM) were used. The lessons were observed and data collected using Classroom Observation Schedule (COS). The obtained data were then analyzed using descriptive statistics with the help of SPSS version 20.0. The study found out that use

Received: **28 Jun 2016** *Accepted:* **20 July 2016** *Published:* **31 July 2016**

Corresponding author: samjesse.samuel@gmail.com

of CAI in teaching science subjects promotes a more active role of the learners such as interacting with learning resources and consulting one another (collaboration) leading to more interest and attention of the learners. The instructional process was found to be more learner-centered with the teacher remaining as a facilitator or a guide to the learners. Various recommendations based on this study were therefore made including ensuring that CAI is implemented in secondary schools, need to provide secondary schools with appropriate ICT infrastructure, organizing CAI in-service courses, seminars and workshops for teachers as well as incorporating CAI in Teachers Training Colleges and university curriculum for pre-service teachers.

***Keywords*:** Computer Assisted Instruction, Conventional Instructional Methods, Instructional method, Learners characteristics and Teachers instructional role.

1. INTRODUCTION

The teaching method that a teacher applies determines the quality of the instructional process and consequently affects the learners' performance. Jesse et al (2014) noted that the instructional methods used by teachers determine the performance of learners to a great extent. It is therefore important for teachers to apply appropriate teaching and learning methods which would ensure successful science instructional process. According to Fraser and Walberg (1995), appropriate instructional activities can be effective in promoting the development of logical thinking, as well as the development of some inquiry and problem solving skills. Such skills are critical in science learning. For effective teaching and learning to occur, the teacher should use an efficient approach of conveying the information to the learner (Brown et al., 1982). In order to increase students' motivation to learn science, a variety of innovative instructional methods can be used (Fraser and Walberg 1995).

Various studies have suggested that inappropriate teaching approaches employed by science teachers in Kenyan secondary schools may a contributing factor to poor performance in science subjects. Most of the instructional methods the teachers use in our classrooms are usually teacher-centered and hence, give learners fewer opportunities or roles to play in the classroom discourse (Kiboss, 2000). Apparently, such situations tend to limit learners' active participation (Tanui, 2003). According to Kolawole (2008), teacher-centered teaching approaches are dominant at the secondary school level where the teacher presents information to students in a lecture and students complete assignments out of the class and later take examinations to demonstrate their degree of understanding and retention of subject matter. UNESCO (2005) in the Education for All, Global Monitoring Report notes that practitioners broadly agree that teacher dominated pedagogy where students are placed in a passive role is undesirable, yet such is the norm in the vast majority of classrooms in Sub-Saharan Africa. Adeyemi, (2008) argued that the lecture method which is predominant in our classrooms does not stimulate innovations, inquiry and scientific thinking but rather encourages students to cram facts which are easily forgotten.

To improve the instructional process, the teaching approaches adopted by a teacher should make learning more learner-centered so as to promote imaginative, critical and creative skills in the learners resulting in more permanent and better achievement of instructional objectives. According to MoEST (2011), the learner-centered teaching and learning approaches actively engage the learner in the learning process for effective mastery of the subject content matter and promotes a positive attitude towards the subject. According to Wambugu and Changeiywo (2008), the teaching approach that a teacher adopts is one factor that may affect students' achievement and therefore use of an appropriate teaching approach is critical to the successful teaching and learning of science. Many topics in science may require

innovative instructional methods such as Computer Assisted Instruction (CAI) to foster the learners understanding and facilitate adequate coverage of most of the science processes and concepts (Nyaga, 2011). Computer-Assisted learning, as a practical student engagement method, is supportive of the constructivist approach which emphasizes acquisition of knowledge and skills by taking responsibility for one's learning.

Computer assisted instruction (CAI) refers to teaching and learning through computer-based programs that mostly involve drill and practice, tutorial and computer simulation activities offered either by themselves or as supplements to traditional, teacher directed instruction (Stennet, 1985). Over the recent years, CAI has witnessed great development in many countries. Capper and Copple (1985) indicated that the single best-supported finding in the research literature is that the use of CAI as a supplement to traditional teacher directed instruction produces achievement effects superior to those obtained with traditional instruction alone. Rupe (1986) observed that as well as enabling students to achieve at higher levels, researchers have also found that CAI enhances learning rate. Student learning rate is faster with CAI than with conventional instruction. According to Kulik (1987), students receiving CAI learn better and faster and students' scores on delayed tests indicate that the retention of content learned using CAI is superior to retention following traditional instruction alone. The success to integrate CAI into teaching and learning of science rests on the teachers to accept and to embrace the new innovation, ability to make informed judgments about the suitability of CAI to meet their particular teaching and learning goals and to consider CAI in their search for new instructional approaches. There was therefore, a great need to investigate the effects of introducing CAI into science instruction in Kenyan secondary schools.

The study reported on this paper was aimed at investigating the influence of the instructional methods on the role of the teacher and learners' characteristics in science lessons. The objectives of the study were to evaluate the role of the teacher in lessons employing conventional instructional methods (CIM) and those employing computer assisted instruction (CAI) and to investigate the characteristics of learners in lessons employing computer-assisted instruction and those employing conventional instructional methods.

2. METHODOLOGY

2.1 Research Design

A research design is a structure of the study and the 'glue' that holds together all the elements in a research project (Kombo and Tromp 2006). Biology, Chemistry and Physics (Science) teachers and Form Two learners from six secondary schools situated in Embu County in Kenya were involved in the study. The Form Two classes in three of the

six secondary schools were randomly assigned Group 1 while the Form Two classes in the remaining three schools were assigned Group 2. Group 1 was taught through Computer Assisted Instruction (CAI) while in Group 2, Conventional Instructional Methods (CIM) were used. During the study period, the researcher visited various classes and observed the characteristics of the learners as well as the role of teacher when the two types of instruction were used. The lessons were observed and data collected using Classroom Observation Schedule (COS). This design is summarized on figure 1.

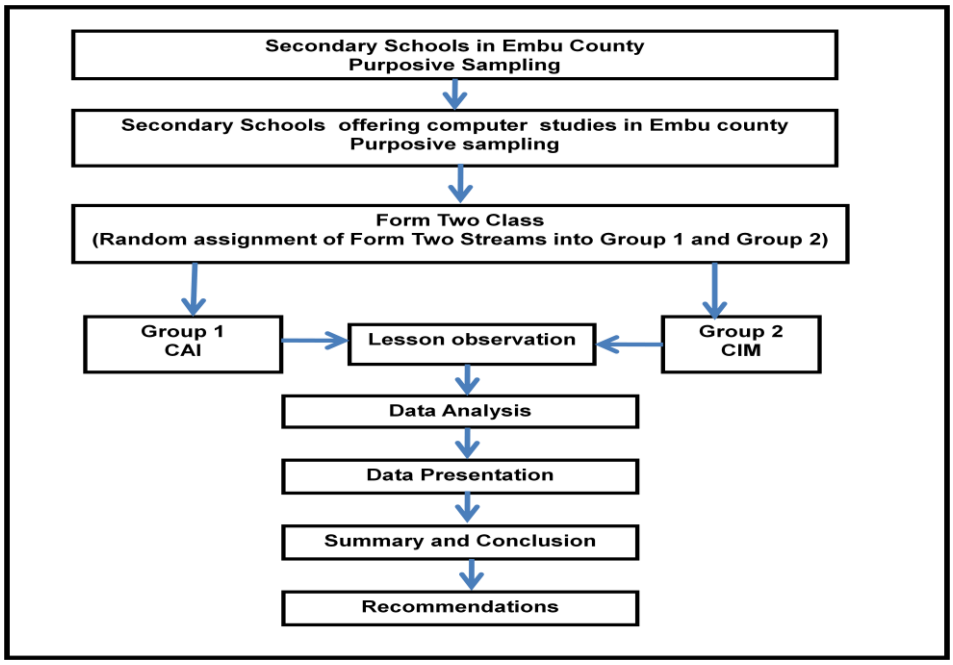

Figure 1: Research Design

2.2 Target Population

The study involved teachers that taught science subjects and students who took Biology, Chemistry and Physics in secondary schools that offered computer studies in three sub counties located in Embu County. These sub counties were Embu west, Embu North and Embu East. Two schools that offered computer studies in each sub-county were selected making a total of six schools with a population of five thousand, two hundred and nineteen students (5,219). Out these, one thousand three hundred and seventy-one (1,371) were Form Two students. The total number of science teachers in the six schools was seventy-three (73), where seventy (70) of them taught the Form Two classes. Table 1 shows a summary of the teachers and learners involved in the study. The table also shows the percentage of the learners and teachers involved in the study which is more than ten percent. This therefore meets the recommended percentage in statistical terms which is ten percent (Orodho and Kombo, 2002).

Table 1: Target Population

Subject	Total Number	Percentage
Total number of students in the six schools	5219	100%
Number of students in form 2	1371	26%
Number of form 2 students involved in the study	892	17%
Total number of science teachers in the 6 schools	73	100
Number of teachers who taught in form 2 level	70	96%
Population of teachers involved in the study	45	62%

2.3 The Sample and Sampling Procedures

According to Webster (1995), a sample is a finite part of a statistical population whose properties are studied to gain information about the whole. Purposive sampling was used to select secondary schools that offered computer studies in Embu County. This was because a key resource that comprises computer laboratories was required for the CAI lessons. Group 1 also required learners with basic computer skills. Six secondary schools that offered computer studies in the county were then randomly selected for the study. In the sample schools, the Form Two classes were purposively selected for the study. This was because the learners at this level had fully adapted to the environment but they have not yet selected the subjects that they would be examined in the Kenya Certificate of Secondary Education examination. The Form Two classes in three of the six sample schools were randomly assigned the Group 1 while in the three remaining sample schools, the Form Two classes were assigned the Group 2. Each study school therefore had a group for Biology, Chemistry and Physics either assigned to group 1 or group 2.

2.4 Research Instrument (Classroom Observation Schedule)

Classroom observation schedule (Appendix I) was used to record the observed behavior and characteristics of the learners in both computer assisted instruction and conventional instruction methods lessons. Characteristics such as the interest of the learners, involvement of the learners and attention of the learners were observed and recorded in the two types of instructions. The role of the teacher in the two types of instructions was observed using this instrument. The observation schedule was used to rate each of the observed aspects into different levels that was determined by its presence during the lesson. The instrument used Likert scale items with five levels: - not at all, a little, fairly adequately, adequately and a great deal.

2.5 Data Collection Procedure

Research permit to carry out the study in schools in Embu County was granted from the National Council for Science, Technology and Innovation (NACOSTI), a government agency in the Ministry of Education, Science and Technology (MoEST) in Kenya. Sampled schools were then visited to seek permission to carry out the research from the school principals. A meeting with the science and computer studies teachers was then organized where basic issues about the study and its benefits were discussed. Confidentiality was guaranteed. Further, teachers were requested to explain to their students about the study since it was expected to affect their normal learning programmes.

The role of the teacher in the two types of instructions was observed using a Classroom Observation Schedule. Various teacher aspects were put into consideration when evaluating the role of the teacher in both CAI and CIM lessons. These aspects included: - the extent to which straight lecture was used, level of questioning, encouragement of the learners to consult each other, answering of the learners' questions, giving of learners' time to interact with the learning resources and the involvement of the teacher in the lesson. In addition to teachers' instructional roles, learners' characteristics were also recorded using a classroom observation schedule. Various aspects of the learners' characteristics or behavior were evaluated. These included: engagement of the learners in meaningful learning activities, learner questions, learners' attention, learners' interaction with each other, Enjoyment of the lesson/ interest, ability to answer questions, interaction with learning resources and ability of learners to make correct observations and conclusions. A total of eighty-three lessons were observed whereby 48% of them were CAI and 52% were CIM lessons. In terms of the subjects being studied, 33.73 were Biology lessons, 32.54% were Chemistry and 33.73% were Physics lessons. The obtained data were then analyzed using descriptive statistics with the help of SPSS version 20.0. The percentage rating and the mean rating were calculated to determine the level at which each aspect was observed during the lessons.

3. STUDY FINDINGS AND DISCUSSION

3.1 Role of the Teacher in CIM Lessons

All the six teacher aspects were evaluated using the five level rating scale depending on their application during the lessons that were observed. Straight lecture was used to a great deal (60.5%) in the CIM lessons that were observed. In many lessons, teachers asked learners' questions fairly adequately (51.2%) while it's only in 46.5% of the CIM lessons observed that the teachers gave learners time to consult each other for a short time. In 41.9% of the lessons, learners were allowed to interact with the learning resources briefly with teachers being directly involved in the lessons to a great deal (69.8%). The CIM lessons were therefore characterized by high involvement of the

teacher and straight lecture. There was however very little interaction among the learners and between the learners and the learning and teaching resources. The rating of all teacher aspects as observed is shown in figure 2.

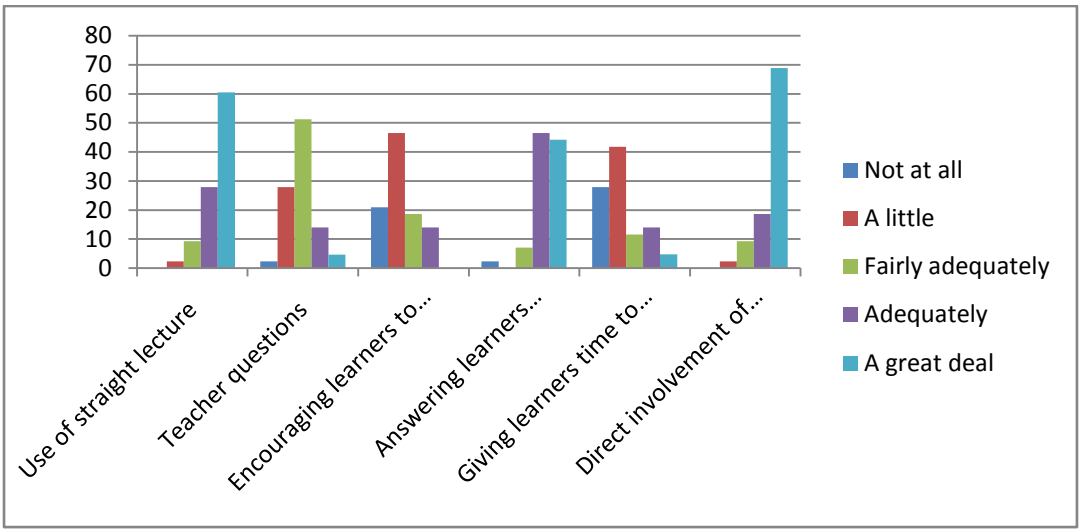

Figure 2: Rating of Teachers' Role in CIM Lessons

3.2 Role of the Teacher in CAI Lessons

In 92.3% of the CAI lessons observed, learners were given time to interact with learning resources to a great deal. This is possibly because learners were operating the resources (mostly computers with digital content) themselves and teachers only served as facilitators. Teachers in CAI encouraged learners to consult each other adequately (66.7%) while straight lecture was used just a little in 69.2% of the lessons. It is only in 51.3% of the lessons observed in CAI where teachers were directly involved in the lesson just a little. Figure 3 summarizes all the aspects of the teachers' role as observed in CAI lessons. The roman numbers represent teacher aspects as allocated in figure 4.

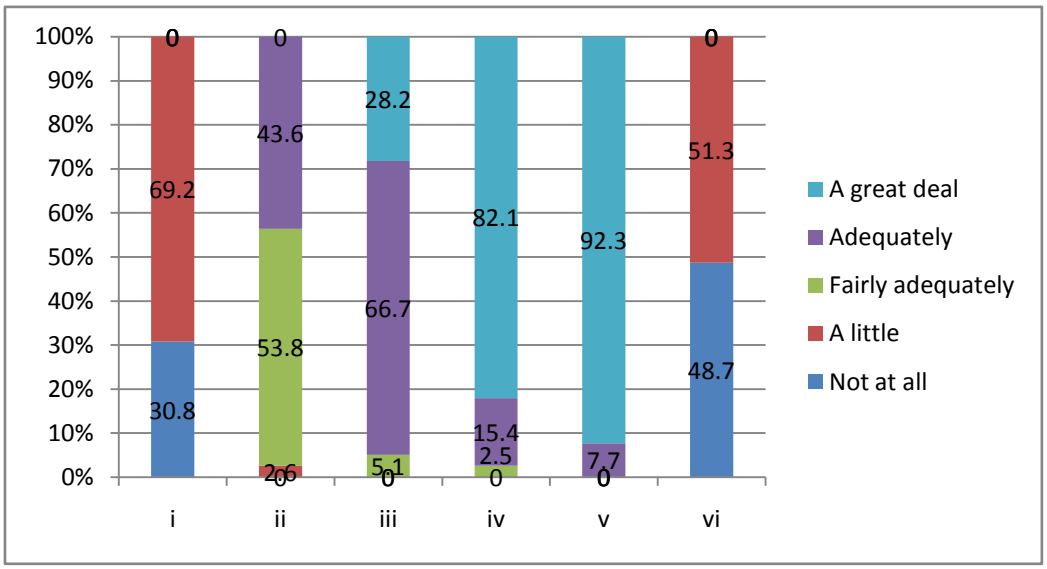

Figure 3: Rating of Teachers' Role in CAI Lessons

3.3 Comparison of Teachers' Role Between CAI and CIM Lessons

It was observed that in CIM lessons, majority of the teachers used straight lecture to a great deal (60%) as compared to CAI lessons where 30.8% of the teachers did not use straight lecture at all and 69.2% used it briefly in most cases just for introducing the lessons. Teachers in CAI lessons encouraged and gave learners time to consult each other adequately (66.7%) while those in CIM lessons only allowed learners consultation a little (46.5%). On learners' interaction with teaching and learning resources, 92.3% of the CAI lessons observed revealed that learners were able to interact with the learning resources to a great deal as opposed to CIM lessons where only 14% of the teachers allowed learners to interact with the learning resources to a great deal. A comparison of all the teacher aspects observed between CAI and CIM is summarized in figure 4.

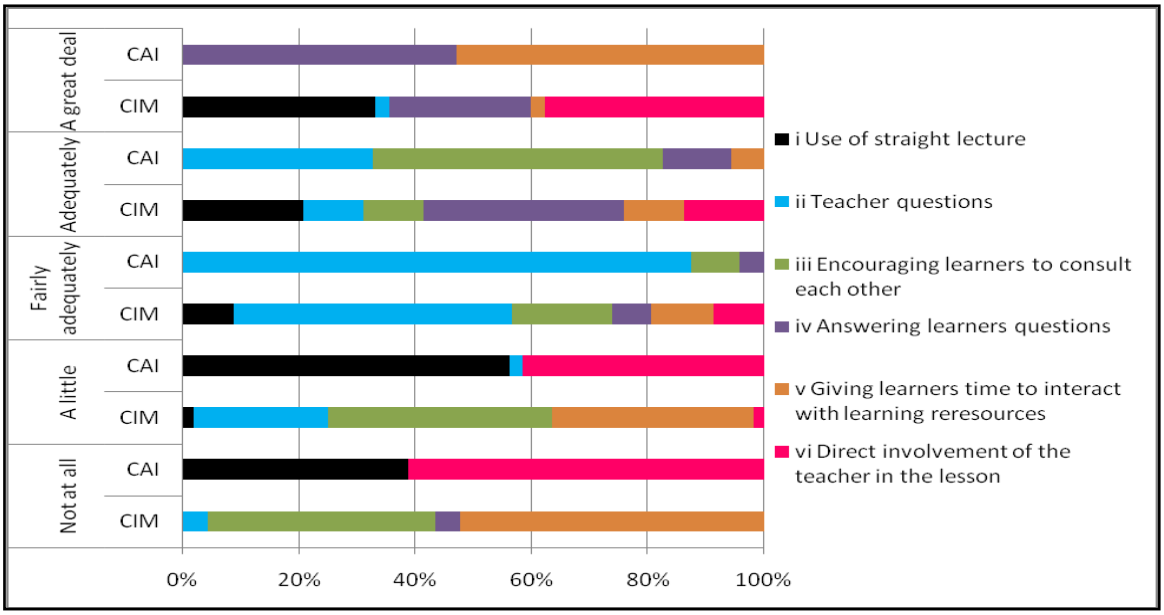

Figure 4: Comparison Between Teachers Role in CIM and CAI Lessons

Mean rating was then calculated by getting the average rating of a particular aspect in all the lessons that were observed that is the total rating of a particular aspect along the five levels rating scale divided by the total number of lessons observed. On average, straight lecture and direct involvement of the teacher had the highest mean rating implying that they were the most commonly observed teacher aspects in CIM lessons. In CAI lessons, encouraging learners to consult and giving them time to interact with the learning resources had the highest mean rating. Asking and answering of questions had almost the same rating in both CAI and CIM lessons. Figure 5 gives a summary of the mean rating of all the teacher aspects observed in both CAI and CIM lessons. The roman numbers represent teacher aspects as allocated in figure 4.

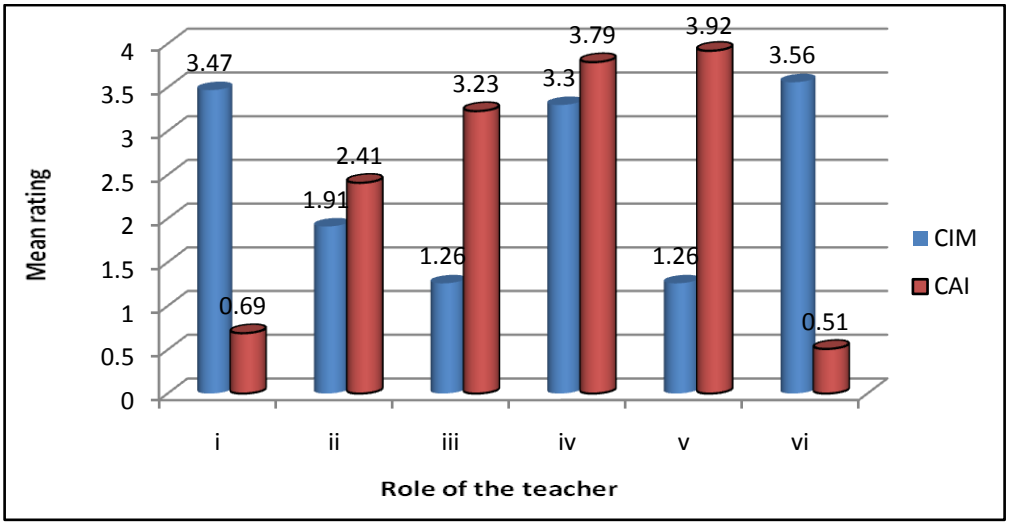

Figure 5: Mean Rating of CAI and CIM Lessons

3.4 Characteristics of Learners in CIM Lessons

The ability of the learners to ask questions, sustaining of the learners' attention, learners' enjoyment of the lesson and provoking of the learners' interest were all observed and rated as fairly adequate in most of the CIM lessons assessed. In 48% of the CIM lessons observed, learners interacted only a little with each other. Similarly, it's only in 41.9% of the lessons observed where learners interacted lightly with the learning resources. The rating of all the learners' characteristics was as shown on figure 6.

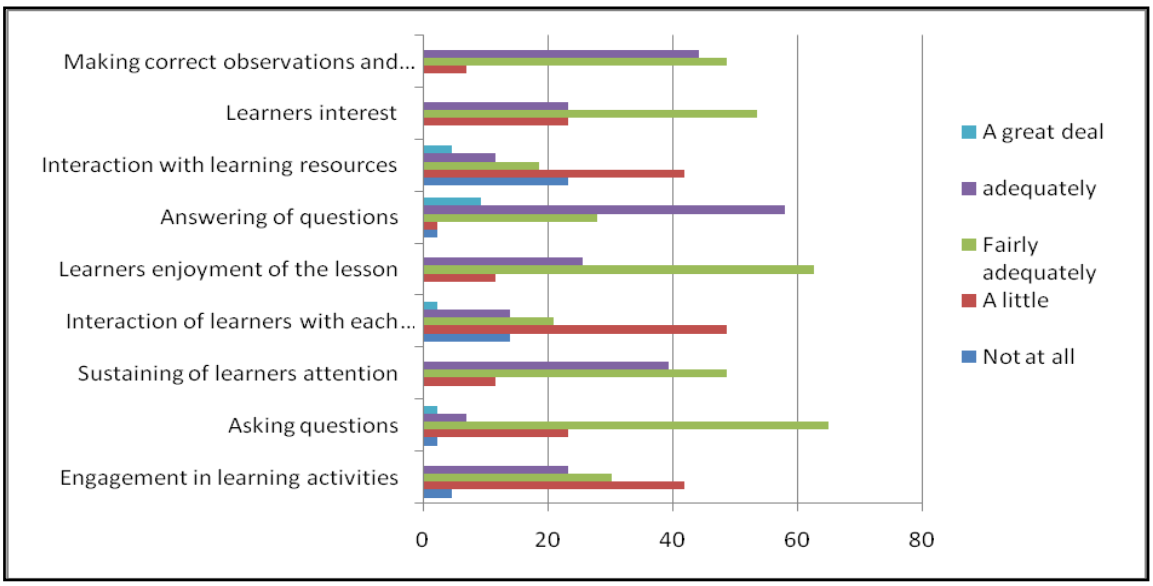

Figure 6: Rating of Learners Characteristics in CIM Lessons

3.5 Characteristics of the Learners in CAI Lessons

Engagement of the learners in meaningful learning activities, sustaining of the learners' attention, enjoying of the lesson by the learners, interaction of the learners with resources and learners' interest were the main features that characterized the CAI lessons. Interaction of the learners with resources was the highest rated characteristic at

97.4% while the learners' interests and their enjoyment of the lessons were both rated at 94.9%. In 92.3% of the CAI lessons observed, learners' attention was sustained a great deal while in 87.2% of the lessons, they were meaningfully engaged in learning activities. Learners were able to make correct observations adequately (71.8%) and their ability to respond to the teachers' questions was also rated as adequate. Learners' interaction during the lesson was rated as adequate while their level of asking questions was rated as fairly adequate (69.2%). Figure 7 shows how the learners' behavior during CAI lessons was rated.

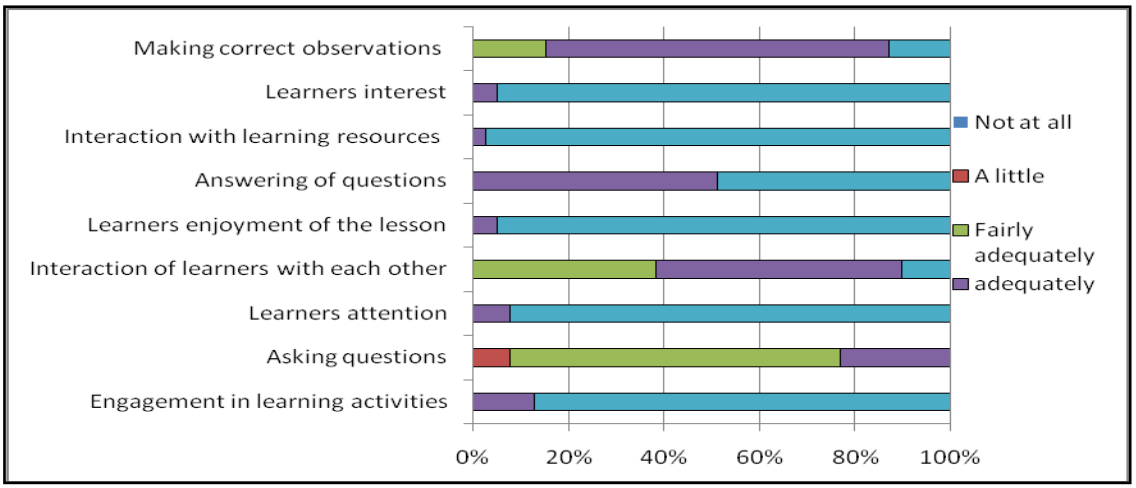

Figure 7: Rating of Learners' Characteristics in CAI Lessons

3.6 Comparison of the Learners' Characteristics in CAI and CIM Lessons

Similarity between the two types of instruction was only realized in two aspects of the learners' characteristics. This was in the asking and answering of questions by the learners whereby the two characteristics had a similar mode of 2 and 3 respectively in both CAI and CIM. This may be attributed to the fact that asking and answering of questions by learners does not necessarily depend on the instructional method being applied in the lesson. The main difference between CAI and CIM was observed in the interaction of the learners with the learning resources where CAI had a mode of four while CIM had a mode of one. This means that in most CAI lessons, learners interacted with the teaching resources to a great deal while in the CIM lessons, learners interacted with the learning resources only a little. Other characteristics that revealed a sharp difference between CAI and CIM include: Engagement of the learners in meaningful learning activities, sustaining of the learners' attention during the lesson, learners' enjoyment of the lesson and provoking of the learners' interest. The most common rating and the mean rating are shown in table 2.

Table 2: Mode and Mean Rating of CAI Compared to CIM Lessons

Learners characteristics		i	ii	iii	iv	v	vi	vii	viii	ix
CAI	Mean	3.8	2.15	3.92	2.7	3.95	3.49	3.97	3.95	2.97
	Mode	4	2	4	3	4	3	4	4	3
CIM	Mean	1.72	1.84	2.28	1.42	2.14	2.70	1.33	2.0	2.37
	Mode	2	2	2	1	2	3	1	2	2

The mean rating was calculated by getting the average rating of all the characteristics while the most common rating (mode) was established by getting the rating of each characteristic that was repeated most times in each case. Figure 8 shows a comparison of mean rating between CAI and CIM. The Roman numbers represent the observed learners' characteristics as allocated in table 5.

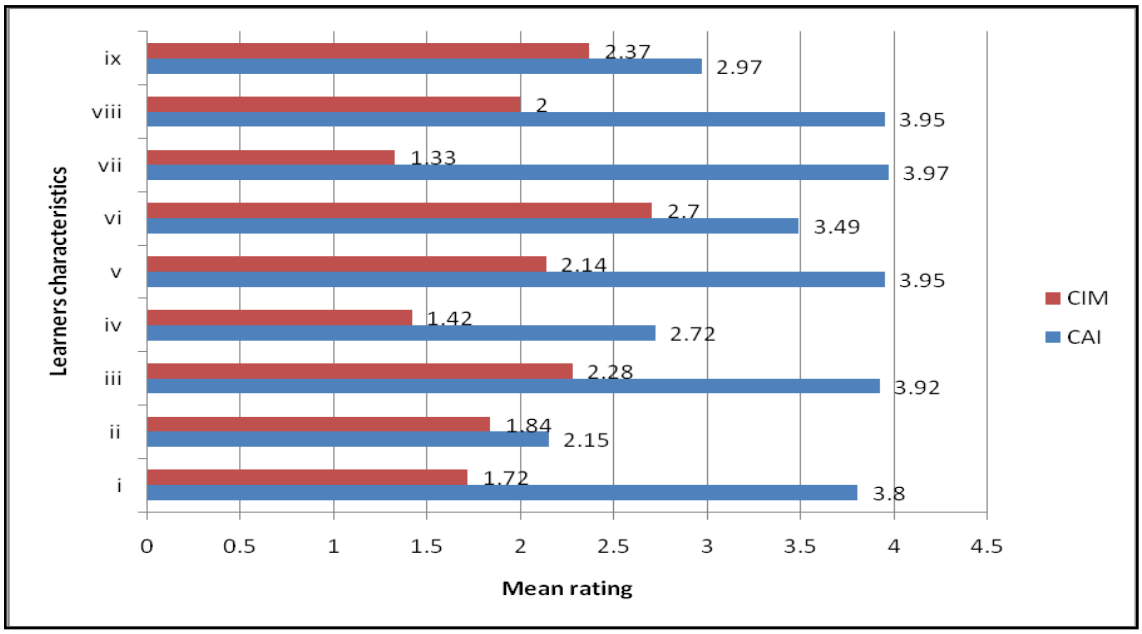

Figure 8: Comparison of CAI and CIM Mean Rating

4. CONCLUSION

The study found out that CIM lessons were characterized by high involvement of the teacher and straight lecture. There was however very little interaction among the learners and between the learners and the learning and teaching resources. On the other hand, engagement of the learners in meaningful learning activities, sustenance of the learners' attention, enjoyment of the lesson by the learners, interaction of the learners with resources and learners' interest were the main features that characterized the CAI lessons. Use of CAI in teaching science subjects therefore promotes a more active role of

the learners such as interacting with learning resources and collaboration leading to more interest and attention of the learners. This confirms the observations by Fraser and Walberg (1995) who noted that use of computer for instruction resulted to increased student interest, co-operation, improved achievement by students in science and an increase in the amount of science curriculum that was covered. CAI is more learner centered whereby the teacher remains as a facilitator or a guide while learners take control of their own learning.

5. RECOMMENDATIONS

The instructional process in science (Biology, Chemistry and Physics) can be improved by implementing CAI in teaching of science subjects. This is because CAI is more interesting, sustains learners' attention and gives learners enough time to interact with teaching and learning resources. Learners are therefore *constructivist,* that is in-charge of their own learning process. The teachers' only role is to guide the learners or facilitate the learning process without directly being involved or dictating what happens during the learning process. This way, there is meaningful learning which leads to better understanding, hence performance in science. But for this to happen, teachers have to be facilitated in terms of resources, particularly the computers and relevant programs. Secondary schools should be provided with appropriate ICT infrastructure and seminars and workshops organized for in-service teachers. Further, CAI courses should be incorporated in Teachers Training Colleges and university curricula to develop the appropriate ICT integration skills in pre-service teachers.

This study winds up with some recommendations for further research. First, an improvement in the instructional process was realized by application of CAI in teaching science subjects. It would be interesting to investigate whether a similar improvement would result when CAI is applied in other subjects. In addition, this study did not consider the gender difference. It is important to find out whether CAI has a positive impact in the instructional process involving both genders.

REFERENCES

Adeyemi, B.A (2008). Effects of Cooperative Learning and Problem Solving strategies on junior Secondary School Students Achievement in Social Studies. Available at:http://www.investigaciopsicopedagogia.org/revista/articulos/16/englishiArt_16_181.pdf. Accessed on 20/7/2013.

Brown, N.R., Oke F.E. and Brown D.P. (1982). Curriculum and Instruction: An Introduction to Methods of Teaching. Macmillan Publishers Limited, Kuala Lumpur.

Capper, J., and Copple, C. (1985) Computer Use in Education: Research Review and Instructional Implications. Washington, DC: Center for Research into Practice.

Fraser, B.J. and Walberg, H.J. (1995): Improving Science Education. Chicago, Illinois: National Societal for the Study of Education.

Jesse, S.N., Twloli, N.W. & Maundu, N.N. (2014). Enhancement of Science performance through Computer-Assisted Instruction among Selected Secondary School Learners in Kenya. Available at: http://kjectl.eku.edu/sites/kjectl.eku.edu/files/files/Volume_12/Vol12_4_Science_Performance_Jesse_etal.pdf. Accessed on 4/02/2015

Kiboss J.K (2000). Teacher/pupil perspectives on computer-augmented physics lessons on measurement in Kenyan secondary schools. J. Inf. Technol. Teach. educ.

Kombo, D and Tromp, A. (2006): Proposal and Thesis Writing: an introduction. Nairobi: Paulines publications Africa.

Kolawole, E.B. (2008). Effects of Competitive and Cooperative learning strategies on Academic Performance of Nigerian Students in Mathematics. Educ. Res. Rev., 3(1).

Kulik, J. A., and Kulik, C. C. (1987) Computer-Based Instruction: What 200 Evaluations Say. Paper presented at the Annual Convention of the Association for Educational Communications and Technology, Atlanta.

Marilyn, P.A., Ruth, V.S. and Sarah, A.C. (2011). Curiosity, Interest and Engagement in Technology-pervasive learning environments: a new research agenda. Education Technology Research Development. Vol. 59: 181- 198.

Ministry of Education (2011): ICT Integration in Teaching and Learning: A manual for teachers and school administrators. Nairobi, Kenya.

Nyaga, S.J. (2011). Comparison of Computer Assisted Instruction and Conventional Instructional Techniques in Science among Selected Secondary Schools in Embu District-Kenya. Master's Thesis presented to Kenyatta University, Nairobi, Kenya.

Rupe, V. S. (1986): A Study of Computer-Assisted Instruction: Its Uses, Effects, Advantages, and Limitations. South Bend, IN: Indiana University.

Stennet, R.G. (1985) Computer Assisted Instruction: A review of reviews. Research report 85-01, London board of education, Education research services.

Tanui, E.K. (2003): Relative effects of a computer-based instruction in accounting on students' achievement, perception of classroom environment and motivation in secondary schools in Kenya. Doctoral Thesis presented to Egerton University, Njoro, Kenya.

UNESCO (2005). Global Monitoring Report; Education for All, the quality Imperative. UNESCO, Paris.

Wambugu, P.W. and Changeiywo, J.M. (2008). Effects of Mastery Learning Approach on Secondary Students Physics Achievement. Eurasia J. Math. Technol. Educ., 4(3); 293-302.

Webster, S. (1995). Educational Research. Competence for Analysis and Applications, 6th edition. New jersey: Macmillan.

APPENDIX I

CLASSROOM OBSERVATION SCHEDULE FOR SCIENCE LESSONS IN SECONDARY SCHOOLS IN EMBU COUNTY

This schedule consists of two parts: -

Part A: personal information

Part B: Assessment of classroom teaching and learning.

PART A: PERSONAL DATA

School name……Subject……..

Class……. Teachers teaching experience……

Academic qualification……Date……..**.....**

PART B: ASSESMENT OF TEACHING AND LEARNING

Indicate your assessment by placing a tick in the appropriate box

(Rating Scale 0-not at all, 1-a little, 2-fairly adequately, 3-adequately, 4-a great deal)

1	**Role of the teacher in the lesson**	**0**	**1**	**2**	**3**	**4**
I	Used straight lecture during the lesson					
II	Asked learners questions during the lesson					
III	Encouraged and gave learners time to consult (collaborate)					
IV	Answered the learners' questions					
V	Gave learners time to interact with the teaching/learning resources					
VI	Teacher was directly involved in the lesson					
2	**Learners behavior /characteristics**	**0**	**1**	**2**	**3**	**4**
I	Learners were meaningfully engaged in learning activities					
II	Learners asked questions during the lesson					
III	learners' attention was sustained during the lesson					
IV	Learners interacted with each other during the lesson					
V	Learners appeared to be enjoying the lesson					
VI	Learners were able to answer the teacher's questions					
VII	Learners interacted with the teaching/learning resources					
VIII	Lesson appeared to be provoke the learners' interest					
IV	Learners were able to make correct observations and conclusions					

Additional comments ……...
……