Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.5, No.32, 2014

Effects of Computer Based Mastery Learning Approach on Students' Motivation to Learn Biology

Peter K. Ronoh
Affiliation: Egerton University, Kenya
Email address: peter.kipkoech.ronoh@gmail.com

Prof. Samwel W. Wachanga
Email address: swachanga@yahoo.com
Egerton University

Prof. Fred N. Keraro
Email address: fred.keraro@yahoo.com
Egerton University

Abstract
This study investigated the effects of using Computer Based Mastery Learning (CBML) approach on secondary school students' Motivation to learn biology. A Solomon's Four Group design Non-equivalent Control Group research design was used in which four co-educational secondary schools were purposively sampled in Bomet District. The four schools were randomly assigned to four groups. Students in all the groups were taught the same biology content. Teachers in the experimental groups taught using CBML approach while teachers in the control groups taught using the conventional methods. The study focused on respiration topic and involved a sample of 167 Form Two students. After two weeks of teaching, all four groups were post-tested using Students' Motivation Questionnaire (SMQ) whose reliability co-efficient was 0.79. Data were analysed using ANOVA, t-test and ANCOVA. Results indicate that students taught using CBML approach had significantly higher scores in SMQ than those taught using conventional approaches. In addition, the study established that there is no gender difference in motivation when CBML is used. The researchers conclude that CBML is an effective teaching approach which should be incorporated in the teaching of Biology.
Keywords: Computer Based Mastery Learning, Student's Motivation, Learning Biology.

Introduction

Biological knowledge has been used throughout the centuries because it has a wide range of applications in many aspects of human life. It's applications in genetic engineering has resulted in the production of high yielding plant and animal species. This has made tremendous contribution towards meeting the demand of food requirements for the ever growing human population (Keraro, Wachanga & Orora, 2007). Biological knowledge has also been applied in branches of medicine such as organ transplant and control of a wide range of diseases. Other areas where biological knowledge has been applied include population control and environmental conservation (UNESCO, 1986)

Secondary school biology enables learners to acquire knowledge and skills useful in every day life and in development of desirable attitudes (Brown, 1995). According to UNESCO (1975), school biology should be relevant to real life and experiences of learners. There is need to change from closely directed learning of facts to conceptual understanding and application of acquired knowledge and skills to solve emerging problems. Students leaving high school should be able to use biology in their daily activities (Rose, 1971; Orora, Wachanga & Keraro, 2005). For this to be realized, effective teaching approaches that enhance learning need to be developed and used in the teaching of biology. Expository approaches cannot stand up to the challenges of the new demands and objectives of biology education hence a fresh look at new approaches should be taken (UNESCO, 1986). In recent years, science educators have used the constructivist approach to enhance students' learning (Trowbridge, Bybee & Powell, 2004). According to Good and Brophy (1995) learners' are seen not just as accessing information but also as constructing their own meanings. Aslop and Hicks (2001) point out that learning of science is essentially an active process. Therefore the teaching of biology should enhance active learner participation.

The actual outcomes of instruction depend largely on what happens in classrooms. If scientific knowledge is presented in terms of proven facts and absolute truths readily communicated through texts and lectures, then students will come to regard science as a static body of knowledge that is founded on well-defined methods (Roth & Roychoudhury, 2003). Knowledge, for these students, consists of memorizing a body of information for later retrieval. If, on the other hand, students actively engage in science processes, they recognize that scientific knowledge is based on experiments in which the meaning of data is negotiated and theories are not absolute. Knowledge, in this context, consists of learning experimental methods and the norms and practices of scientific communities as much as it does learning known facts and current theories within a domain (Wheeler, 2000).

In teacher-centred instruction, learning focuses on the mastery of content, with little development of the skills and attitudes necessary for scientific inquiry. The teacher transmits information to students, who receive and memorize it. Assessments of knowledge typically involve one right answer. The curriculum is loaded with many facts and a large number of vocabulary words, which encourages a lecture format of teaching (Leonard & Chandler, 2003). In contrast, in a student-centred curriculum, learning science is active and constructive, involving inquiry and hands-on activities. The goal is to develop critical thinking and problem-solving skills by posing and investigating relevant questions whose answers must be discovered. The teacher acts as a facilitator, creating the learning conditions in which students actively engage in experiments, interpret and explain data and negotiate understandings of the findings with peers. In this approach, the teacher puts less emphasis on memorizing information and more emphasis on inquiry and hands-on activities through which students develop a deeper knowledge and appreciation of the nature of science (National Research Council, 1996; Singer, Marx, Krajcik & Chambers, 2000). Thus when learners are actively involved during the instructional process, their motivation to learn would improve.

Computer based instruction (CBI) provides individualized instruction and therefore learning occurs at learners own pace and time frame (Curtis & Howard, 1990; Munden, 1996). CBI is likely to enhance learning and improve retention rate of students. Coller (2004) indicated that instruction supplemented by properly designed CBI is more effective than instruction without CBI. Alessi and Trollip (1991) emphasized that there are four major types of CBI programmes namely: Tutorials, Drills and practice, instructional games and simulations.

Kiboss, Tanui and Nassiuma (2003) observed that the use of CBI Simulation has proved successful in teaching difficult concepts in Physics, Biology, Mathematics and Geography. No empirical research has specifically examined the dynamics of one to one computer tutorials and their effects on solving related problems (Hepper et al., 1993). Using the tutorials, students will hopefully internalize the concepts presented. It is on this basis that CBI tutorial was adapted in this study.

Mastery Learning Approach (MLA) is an instructional method where students are allowed unlimited opportunities to demonstrate mastery of content taught (Kibler, Cegala, Watson, Baker & Miler, 1981). MLA involves breaking down the subject matter to be learned into units of learning, each with its own objectives. Results from research studies on MLA shows that there is better retention and transfer of material, yields greater interest and more positive attitudes (Wachanga & Mwangi, 2004).

In this study, the elements of mastery learning were incorporated into the CBI tutorial. The tutorial used the visual basic language. Lessons were presented using computer and students went through the tutorial in the topic respiration. At the end of each objective in the lesson were quizzes. The students were required to answer and upon attaining 80% they could be allowed to move to the next topic. This approach was referred to as Computer Based Mastery Learning (CBML). This study investigated the use of this approach on secondary school students' motivation to learn biology. The study also sought to establish whether there were any gender disparities in motivation to learn.

Theoretical Framework

Constructivism is the theoretical framework that guided this study. Constructivists believe that what gets into the mind is not transmitted or poured by some external manipulator but has to be constructed by the individual through knowledge discovery or social interaction. Learning takes place when individuals participate actively in meaningful activities. They construct both a mechanism for learning and their own unique version of knowledge, coloured by background experiences and aptitudes (Roblyer & Edwards, 2000; Hsu, Chen & Hung, 2000).

From the constructivist perspective learning is an active process in which each learner is engaged in constructing meanings whether from text, dialogue or physical experiences (Osborne, 1983). Active learning occurs when learners are challenged to exert their mental abilities actively while learning (Hout-wolters, Simons & Volet, 2000). Learners are actively seeking meaning (Kirschner, Martens & Strijbos, 2004) and are expected to be the architects of their own learning (Glaser, 1991).

Dwyer (1991) asserts that this approach is learner centered rather than curriculum centered. CBML which is interactive would enable learners to control the pace and sequence of their learning is tied to this theory (Drillscol, 2000). In CBML learners study the lesson on their own with the guidance of the teacher and answer the assessment questions at the end of the lesson unit. They are allowed to proceed to subsequent unit upon attainment of eighty percent (80%), otherwise they repeat until they attain the standard percentage this will enable the learners to construct their own knowledge.

Conceptual Framework

Figure 1 shows the conceptual framework that guided the study.

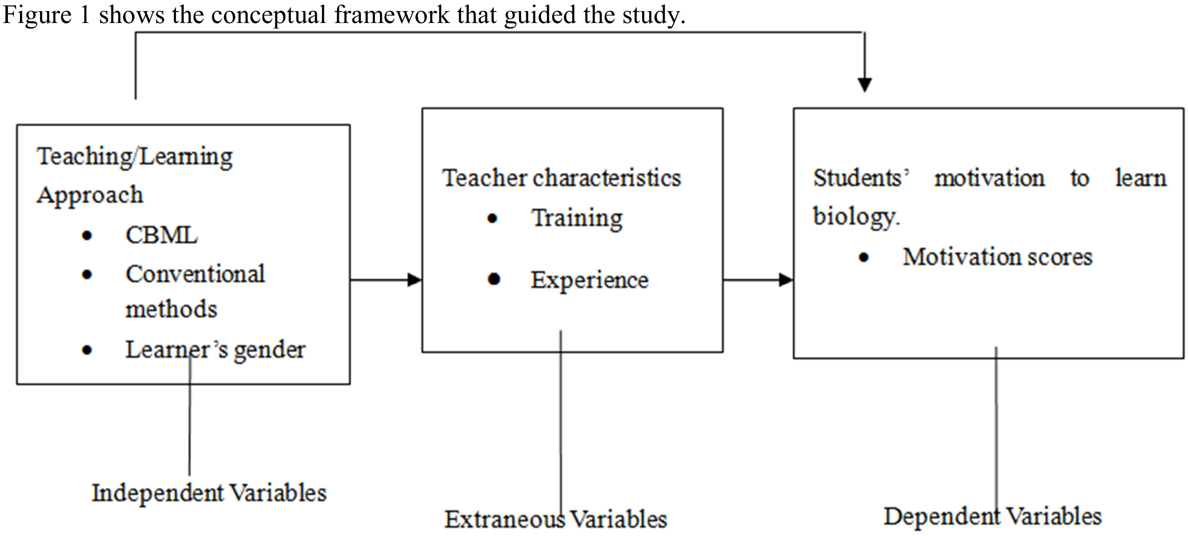

Figure 1: Conceptual Framework for Determining the Effects of using CBML Teaching Approach on Students' Motivation towards Learning Biology.

The conceptual framework shows CBML as an intervention in the teaching/learning approach of biology topic respiration, which aid motivation in the subject. The dependent variable in this study is the student's motivation towards the topic respiration. The independent variables are CBML, regular teaching/learning approaches and gender. The intervening variables are learner's age, teacher's training and experience. Teachers training was controlled by using teachers trained to teach biology at secondary school level with a minimum qualification of Diploma Certificate. Teacher's experience was controlled by using teachers who have been teaching biology at secondary school level for at least three years.

Purpose of Study

This study sought to determine the effects of CBML on students' motivation to learn in Provincial co-educational secondary schools in Bomet District, Kenya. It also sought to compare boys' and girls' motivation when taught using CBML.

Objectives of the Study

1. To establish whether there is a difference in motivation to learn biology between students exposed to CBML and those exposed to conventional teaching/learning approach.
2. To find whether there is a gender difference in motivation to learn biology when students are exposed to CBML

Hypotheses of the Study

To achieve the objectives of this study the following null hypotheses were tested.

Ho1: There is no statistically significant difference in motivation to learn biology between students exposed to CBML and those exposed to conventional teaching/learning approaches.

Ho2: There is no statistically significant gender difference in motivation to learn biology when students are exposed to CBML.

Research Design

This study used the Solomon's Four non-equivalent control group design. This design is appropriate for experimental and quasi-experimental studies (Wachanga & Mwangi, 2004; Keter & Wachanga, 2013). The design overcomes external validity weaknesses found in other designs and also provides more vigorous control by having two control groups as compared to other experimental designs (Koul, 1984). This design involves a random assignment of intact classes to four groups. The study adopted a quasi- experimental design, as the subjects were already constituted and school authorities don't allow reconstitution for research purposes (Borg & Gall, 1989). The design is shown in figure 2.

O_1	X	O_2	Experimental group E_1
O_3	-	O_4	Control group C_1
-	X	O_5	Experimental group E_2
-	-	O_6	Control group C_2

Key: Pre-tests: O_1 and O_3; Post- tests: O_2, O_4, O_5 and O_6; Treatment: X
Figure 2: Solomon Four- Group design, non- equivalent control group research design

Sample Size and Sampling Procedures
A sample of 167 subjects was used. Purposive sampling was used to select four secondary schools which offer computer as one of the teaching subjects. Four schools were chosen because each school formed a group in the Solomon Four Group Design so that the interaction is minimized during the exercise. The selection of the schools and assignment of one form two stream per school selected to either experimental or control groups was done using simple random sampling. Balloting was used; this entailed assigning serial numbers to form two streams of the participating schools and picking one at a time respectively.

Students' Motivation Questionnaire (SMQ)
The SMQ was used to assess students' motivation to learn biology. The researcher adapted and modified the SMQ developed by Kiboss (1997) to suit the current study. The instrument had 20 items. The items were constructed on a five point Likert scale. The responses to questions include strongly agree, agree, undecided, disagree and strongly disagree. All the choices were abbreviated as SA, A, U, D & SD respectively. SA was assigned 5 points where else SD was assigned 1 point. The items tested interest and confidence towards learning biology. The rating scale's minimum score was 20 marks and the maximum was 100 marks.

Development of Instructional Materials
The researchers developed an instructional manual for the teachers involved in the use of CBML. The manual focused on objectives, content to be covered in the topic and teaching/learning activities. The manual was based on revised Kenya Institute of Education (KIE) (2002) biology syllabus. Teachers of the experimental groups were trained by the researchers on how to use CBML for four days. This was to enable them master the skills of using CBML approach.

Data Collection Procedures
Prior to the start of the topic, the experimental groups E_1 and E_2 had to undertake an orientation course using the CBML manual under their teachers' supervision to familiarise with the computers and the CBML software. Students Motivation Questionnaire (SMQ) was administered to the experimental group (E_1) and control group (C_1) as a pre-test.

The experimental group $E_1$and E_2 were taught using CBML approach within a period of two weeks with the help of cooperating biology teachers while control groups C_1 and C_2 were taught using the conventional methods of teaching. Students Motivation Questionnaire (SMQ) was administered as a post-test to all the four groups at the end of teaching.

Data Analysis
Data were analysed using one way ANOVA and analysis of covariance (ANCOVA). Analysis of variance (ANOVA) was used to identify the difference in post test mean scores between experimental and control groups. A t-test was used to test differences between the pre-test mean scores because of its superior quality in detecting differences between two groups (Borg & Gall, 1989). Analysis of covariance (ANCOVA) was used to cater for initial differences in the treatment and the control groups. The covariate was the KCPE marks. All tests of significance were performed at alpha level 0.05.

Results
The Solomon four- group design used in this study enabled the researcher to have two groups sit for pre-tests. Experimental group 1 (E_1) and Control group 1(C_1) sat for pre-test SMQ.
The results of the t-test of the pre-test scores on the SMQ for groups E_1 and C_1 showed no significant difference t (0.631) =0.530, $p > 0.05$.

Effects of CBML approach on students' motivation in biology

To establish whether the experimental (E) and the control groups (C) were similar at the beginning of the study the pre-test scores of SMQ were analysed using independent sample t-test. The results are shown in table 1.

Table 1

Independent sample t-test of pre-test scores on SMQ based on groups E_1 and C_1

Scale	Group	N	Mean	SD	*df*	t-value	*P*value
SMQ	C1	37	2.76	0.55	78	0.631	0.530
	E1	43	2.82	0.46			

Table 1 shows that the pre-test mean scores in SMQ for control group 1 (C_1) was (M = 2.76, SD = 0.55) while for experimental group 1 (E_1) was (M = 2.82, SD = 0.46), t (0.631) = 0.530, $p > 0.05$. This showed that there was no significant difference in motivation between the control group 1(C_1) and experimental group 1(E_1). This implies that the two groups had similar characteristics in respect to motivation and were therefore suitable for study.

To determine the relative effects of the CBML approach on students' motivation in biology, an analysis of students' post-test mean scores in SMQ was carried out. This was to test hypothesis Ho1 which sought to establish whether there was significant difference in motivation to learn biology between students exposed to CBML approach and those exposed to conventional teaching/learning approaches. Table 2 shows post-test SMQ mean scores obtained by students in the study groups.

Table 2

Post-test SMQ means scores obtained by students in the study groups

Group	N	Mean	*SD*
C_1	37	3.31	0.49
C_2	36	3.61	0.50
E_1	42	3.88	0.35
E_2	41	3.93	0.33

Table 2 shows that E_1 had (M = 3.88, SD = 0.35) and E_2 had (M = 3.93, SD = 0.33) which is higher than that of C_1 (M = 3.31, SD = 0.49) and C_2 (M =3.61, SD = 0.50). Hence CBML approach enhanced students' motivation to learn. In order to determine whether the difference in experimental groups (E_1 and E_2) and control groups (C_1 and C_2) were significant a one way ANOVA was used. Table 3 shows the results of the post-test scores on the SMQ.

Table 3

One way ANOVA of the post-test scores on the SMQ

Scale	Sum of Squares	*df*	Mean Square	*F*-ratio	*P*-value
Between Groups	9.291	3	3.097	17.506	0.000*
Within Groups	26.89	152	0.177		
Total	36.18	155			

The results on table 3 indicate that the difference in motivation between the four groups were significant, F (3,152) = 17.506, $p < 0.05$.

To determine where the differences occurred, post-hoc multiple comparisons were carried out. The results are shown in Table 4.

Table 4
Post hoc multiple comparison of the post- test SMQ means for the study groups

Group	Mean difference	*p* - value
C_1 vs C2	-0.294*	0.017
E1	-0.567*	0.000
E2	-0.612*	0.000
C_2 vs C1	0.294*	0.017
E1	-0.274*	0.024
E2	-0.319*	0.006
E1 vs C1	0.567*	0.000
C2	0.273*	0.024
E2	-0.045	0.963
E2 vs C1	0.612*	0.000
C2	0.318*	0.006
E1	0.045	0.963

The results in table 4 show that the pairs of SMQ scores of groups C_1 and C_2, groups C_1 and E_1, groups C_1 and E_2, groups C_2 and E_2, groups C_2 and E_1 were significantly different. However no significant differences occurred between experimental groups (E_1 and E_2) and control groups (C_1 and C_2). From table 4, it was evident that the mean score of experimental groups were much higher than those of control groups. It was necessary to carry out ANCOVA to help in confirming the results obtained in table 4. The SMQ mean scores were adjusted for ANCOVA with KCPE scores as covariates. Table 5 shows the results of adjusted SMQ mean scores obtained by students.

Table 5
Adjusted SMQ means scores obtained by students

Group	Mean	*SD*
C_1	3.32	0.49
C_2	3.61	0.50
E_1	3.88	0.35
E_2	3.92	0.32

Table 5 shows that when SMQ mean scores are adjusted groups E_1 ($M = 3.88$, $SD = 0.35$) and E_2 ($M = 3.92$, $SD = 0.32$) had higher means than C_1 ($M = 3.32$, $SD = 0.49$) and C_2 ($M = 3.61$, $SD = 0.50$). ANCOVA procedure was used to confirm if the experimental groups and control groups scores were significantly different. Results are shown in Table 6.

Table 6
ANCOVA of the post test SMQ scores with KCPE marks as the covariate

Scale	Sum of squares	*df*	Mean Square	*f*-ratio	*P*-value
Contrast	9.078	3	3.026	16.752	0.000*
Error	26.735	148	0.18		

The results in table 6 indicates that the difference between the two groups is significant, $F(3, 148) = 16.752$, $P < 0.05$. This confirms the one way ANOVA results. This means that the use of CBML approach resulted in higher students' motivation than the regular teaching approaches. Hypothesis Ho1 which states that there is no statistically significant difference in the level of motivation to learn biology between students exposed to CBML and those exposed to conventional learning approach was rejected at 0.05 alpha level.

Motivation of male and female students who were exposed to CBML Teaching Approach
To find the gender difference in motivation SMQ mean scores for male and female students were compared. Table 7 shows the pre-test SMQ mean scores and the independent sample t-test for male and female students who were exposed to the CBML teaching approach.

Table 7
Pre-test SMQ mean scores and independent sample t-test for male and female students exposed to conventional teaching approach

Gender	N	Mean	*SD*	*df*	*t*-value	*p*- value
Male	50	2.83	0.43	78	1.026	0.308
Female	30	2.73	0.36			

The results indicate that the mean score for male students was 2.83 with a standard deviation of 0.43 and that of females was 2.73 with standard deviation of 0.36. The results also indicate that the difference between the SMQ mean scores for males and females t (78) = 0.38 is not significant at alpha level of 0.05. This, therefore means that the male students and female students were at the same level of motivation in learning biology at the start of the treatment. Table 8 shows the post-test SMQ mean scores.

Table 8
Post-test SMQ mean scores and independent sample t-test for male and female students exposed to CBML approach

Gender	N	Mean	*SD*	*df*	*t*-value	*P*-value
Male	39	3.50	0.52	71	0.807	0.422
Female	34	3.41	0.51			

Results in table 8 indicates that comparison of the two scores using t-test yielded a t (71) = 0.87, $P > 0.05$. These, therefore means that there was no gender difference in the level of motivation to learn biology at the end of the CBML intervention.

Discussion

The findings of this study showed that CBML enhanced students' motivation to learn. Lowerison, Sclater, Schmid and Abrami, (2006) notes that, in general there is evidence that student's respond positively to computer use by the teacher. According to Becker (2000), students are generally more on a task and express more positive feelings when they use computers than when they are given other tasks to do. However, the positive response is linked to an active participation of the learners. If the learner is passive, the technology has less effect in increasing student interest and motivation to achieve. Teacher directed technology that is limited to a reproduction of old material using technology like using power point to display written notes is not considered a beneficial use of technology (Lowerison et al 2006).

Findings of this study agrees with findings of a study by Cordova and Lepper (1996), where elementary students were subjected to three different abstract learning strategies designed to allow students to tailor the contents to their own needs under direction of the teachers. The strategies utilized educational computer games and led to increased intrinsic motivation to achieve. Similar results were found in a study with middle school students and their views on technology in school. Students valued the use of computers in school because computers and other technologies were such a big part of their lives outside school (Spires, Lee & Turner, 2008). As Prensky (2007) contents, these students are digital natives, and technology use is what they know and are comfortable with. Collete and Collete (1989) explain that using computers increases motivation and desire for the lectures and laboratory in the process of learning.

The other major finding in this study was that there was no significant gender difference in motivation to learn biology. The Motivation mean score for boys who were exposed to CBML was found to be 3.50 while the mean score for girls also exposed to CBML was 3.41. The difference between the two means was found not to be statistically significant $t(71) = 0.807$ $p>0.05$. This indicates that girls were as equally motivated as boys to learn during the treatment period.

This seems to support earlier studies which show that boys are equally motivated as girls to learn biology (Keraro, Wachanga & Orora, 2002). It contradicts earlier studies which show that girls have more positive attitudes towards biology and hence are more motivated to learn biology than boys (Keeves & Kotte, 1992; Dawson, 2000; Proko, Tuncer & Chuda, 2007). A study by Shihusa and Keraro (2009) on the effect of use of advance organizers on students' motivation found that male students had a significantly higher level of motivation than their female counterparts. This may be attributed to the fact that as Wachanga (2002) has argued, teachers treat boys and girls differently and in ways that often are not beneficial to girls motivation and achievement.

Conclusion
Based on the findings of the study, the following conclusions have been reached.
(i) Students taught using CBML approach have a higher motivation to learn biology than those taught using conventional teaching/learning approach.
(ii) There is no gender difference in motivation to learn biology when students are taught using CBML approach.

Implications of the Study
The findings of this study have indicated that the use of CBML in the teaching of biology in secondary schools results in higher students' motivation to learn biology. When this approach is used, the students' gender does not affect their motivation to learn. This would, therefore, imply that its incorporation in teaching would boost the learning of biology in schools. This in turn would improve the poor achievement at KCSE biology examinations. Educational administrators and designers of computer based learning programmes should emphasize the use of CBML in biology lessons and possibly other science subjects in their effort to boost students' motivation. This will in turn lead to better achievement in biology. Teacher training institutions such as universities should also incorporate the CBML concepts in their training curriculum in order to empower teachers to use the new approach.

References
Adewuyi, M.A. (2001).*Teacher and student Related variables as correlated of Achievement in Mathematics in Oyo State of Nigeria*. Unpublished M.Ed Dissertation. University of Ibadan, Ibadan.
Alessi, S.M. & Trollip, S.R (1991). *Computer Based Instruction: Methods and Development,* England Cliffs: New Jersey.
Alsop, S. & Hick, S.K.(2001). *Teaching Science.* A hand book for primary and secondary school teachers. Glasgow. Bell and Basin Ltd.
Becker, H.J (2000). Pedagogical motivations for student computer use that lead to student engagement. *Educational Technology,47, 465-489*
Bitter, G.G. & Pierson, M.E. (1999). *Using Technology in the classroom, Fourth Edition.* Boston: Allyn and Bacon.
Borg, W.R. & Gall M.D. (1989*). Educational Research: An Introduction,* 5th Ed. White plains, NY: Longman.
Brown C.R (1995). *The Effective teaching of Biology.* New York. Longman.
Burns, W. G., & Bottino, J. P. (1989). *The science of genetics* (6th ed.) New York: Macmillan Publishing Company.
Changeiywo, J.M. (2000*). Students' Image of science in Kenya: A comparison by Gender Difference, Level of schooling and Regional Disparities.* Unpublished PhD Thesis. Egerton University, Njoro.
Codorva, D.I., & Lepper, M.R (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualization, Personalization and choice. *Journal of educational Psychology*, 88, 715-730.
Coller, E S. (2004), *The Enhancement of the Teaching and the Learning of the Sciences in Schools Using Computer Assisted Instruction* http://members.aol.com/esocollier/computer- assistedinstruction.html date retrieved 20TH April 2011.
Collete, A. T. & Collete, E.L (1989) Science introduction in the middle and secondary schools (2nd end.) Ohio, USA: Merrihill Publishing Company.
Curtis, C.M.& Howard, M.K. (1990). A comparison study of the Effectiveness of CAI and Traditional Lecture Techniques as Method of staff Development for Nurses. Retrieved from www.widowmakers.com *on september 20, 2002*
Dawson, C. (2000). Upper primary boys'and girls' interest in science: Have they changed since 1980? *International Journal of Science Education, 22(6), 557-570.*
Driscoll, M. P. (2000). *Psychology of learning for instruction*. Needham Heights, MA:Allyn & Bacon.
Gall, M. D., Borg, W. R., & Gall, J. P. (1996). *Education research an introduction* (6th ed.). White plains N.Y: Longman.
Glaser, R. (1991). The maturing of the relationship between the science of learning and cognition and educational practice. *Learning and Instruction, 1*, 129-144.
Good,T., & Brophy, J. (1995). *Contemporary educational psychology*. (5th ed.) New York: Haper Collins.
Hout-Wolters, B., Simons, P.R & Volet, S. (2000). *Active learning: Self directed learning and independent work*. Kluwer Academic Publishers.
Hsu, J.J, Chen, D. & Hung, D. (2000). Learning theories and IT: The Computer as a Tutor, In Williams , M.D. (Ed) (2000). *Integrating Technology into Teaching and Learning Concepts and Applications*.(2nd Edition). Singapore: Prentice Hall Inc.
Johnson D.W. & Johnson R.T. (1992). Positive interdependence. Key to effective Cooperation. In R. Hertz-

Lazarowitx & N. Miller (Eds), *Interaction in cooperative groups* (pp. 174-199). Cambridge: Cambridge University Press.

Kenya National Examination Council (2010). *Kenya certificate of Secondary Education Examinations Report.* Nairobi: KNEC.

Keeves, J. & Kotte, D. (1992). *Disparities between the sexes in science education:* 1970-84. In J. Keeves (Ed.), The IEA study of science III. New York: Pergamon, pp. 141-164.

Keraro, F. N., Wachanga, S. W., & Orora, W. (2007). Effects of cooperative concept Mapping teaching approach on secondary school students motivation in biology, Gucha District, Kenya. *International Journal of Science and Mathematics Education,* 5, 111-124.

Keter, K.J,.Wachanga, S.W. (2013). Relative Effects of Cooperative Mastery Learning Teaching Approach on students' Motivation to learn Chemistry in secondary schools in Bomet County, Kenya. *International Journal of Social Science & Interdisciplinary Research*

Kibler R.J, Cegala D.J, Watson K.W, Barkel L.L and David T.M (1981); *Objectives for Instruction and Evaluation.* Allyn and Bacoin Inc. Toronto, U.S.A.

Kiboss J.K. (1997). Relative effect of a Computer Based Instruction in Physics on Students' Attitudes, Motivation and Understanding about Measurement and Perceptions of Classroom Environment *.Unpublished PhD Thesis, University of Western Cape, Bellville.*

Kirschner, P.A., Martens, R.L., & Strijbos, J.W. (Eds.) (2004). CSCL in higher education? A framework for designing multiple collaborative environments. In: J.W. Strijbos, P.A. Kirschner & R.L. Martens (Eds.), *What we know about CSCL: And implementing it in higher education* (pp. 3-30). Boston, MA: Kluwer Academic Publishers.

Leonard, W.H., & Chandler, P.M. (2003). *Where is the inquiry in biology textbooks*? The American Biology Teacher, 65, 485–487.

Lowerison G., Sclater, J.,Schmid, R.F., & Abrami, P.C.(2006). Student perceived effectiveness of computer technology use in post secondary classrooms. *Computers in Education,* 47, 465-489.

Munden, C.D. (1996). *What is Computer Assisted Instruction*? Retrieved from www. Google.com.

National Research Council. (1996). *The national science education standards*. Washington, DC: National Academy Press.

Prensky,M.(2007). Listen to the natives. *Educational Leadership* 63(4), 8-13. http://www.iubs.org/test/biont/39/8.htm

Proko, P., Tuncer, G. & Chuda, J. (2007). Slovakian students' attitudes towards biology. *Journal of Mathematics, Science and Technology Education,* **3(** 4), 287-295.

Rose, B. (1971). *Modern trends in education*. London: The MaCmillan press Ltd.

Roth, W., & Roychoudhury, A. (2003). Physics students' epistemologies and views about knowing and learning. *Journal of Research in Science Teaching*, 40(suppl), S114–S139

Roblyer, M.D. & Edwards J.(2000). *Integrating Educational Technology into Teaching*. (Second Edition). Upper Saddle River: Prentice Hall Inc.

Spires, H.A., Lee, J.K.,& Turner K.A. (2008).Having our say: Middle grade student perspectives on school, technologies and academic engagement. *Journal of Research on Technology in Education.*

Tanui, K.E., Kiboss, J.K., Walamba, A.A & Nassiuma, D. (2003). Teachers' changing roles in computer assisted roles in Kenyan secondary schools. *Educational research and Review Vol. 3 (8), pp. 280- 285.*

Trowbridge, L.W., Bybee, R.W. & Powell, J.C. (2004). *Teaching Secondary School Science*. 8th ed. Upper Saddle River, NJ: Pearson prentice Hall.

Shihusa, H. & Keraro, F.N. (2009). Using Advance Organizers to Enhance Students' Motivation in Learning Biology. *Eurasia Journal of Mathematics, Science & Technology Education,* **5**(4), 413-420

Singer, J., Marx, R.W., Krajcik, J., & Chambers, J.C. (2000*). Constructing extended inquiry projects*: Curriculum materials for science education.

UNESCO. (1986). *A Handbook for biology teachers in Africa.* Paris.

UNESCO. (1975). *Science in Basic Functional Education*. *Philosophy Approaches, Methods and Materials: Report.* Bangok UNESCO.

Wachanga, S.W. (2002), Effects of Co-Operative Class Experiment Teaching Method on Secondary School Students' Motivation and Achievement in Chemistry. *Unpublished PhD Thesis, Egerton University, Kenya.*

Wachanga , S.W. & Mwangi, J.G. (2004). Effects of the Cooperative Class Experiment Teaching Method on Secondary School Students' Chemistry Achievement in Kenya's Nakuru District. *International Education Journal*, v5 p26-36.

Wheeler, G.F. (2000). Three faces of inquiry. In J. Minstrell & E.H. van Zee (Eds*.), Inquiring into inquiry learning and teaching in science* (pp. 14–19). Washington, DC: American Association for the Advancement of Science.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar