EFFECTIVENESS OF COMPUTER BASED INSTRUCTION ON STUDENTS' ACHIEVEMENT IN MATHEMATICS IN SECONDARY SCHOOLS IN KENYA

By

Dr. Wanjala Martin M. S. (Seniour Lecturer, Mathematics Education, MMUST, Kenya)

ABSTRACT

The paper reports findings of a study which sought to investigate the effectiveness of computer-based instruction in the teaching and learning of mathematics. It focused on students' achievements in mathematics and on students' attitudes and motivation towards learning mathematics course. This was an experimental study that adopted the quasi-experimental and qualitative research designs. The population of the study comprised all the form three students in selected secondary schools of Bungoma County, Kenya. Convenient sampling was used to select eight schools from which 240 students were randomly assigned to four treatment groups. All the four groups were taught the same mathematics content on the topic of probability. However, two experimental groups received their instruction through the CBI mode while the other two were taught using the conventional methods of instruction. The course lasted for a duration of four weeks. Both the pretest and posttest were administered to the control and experimental groups prior to and after instruction. A comparison of the response variables (achievement, attitudes and motivation) was made between the two forms of instruction using pre-test, treatment and post-test experimental design. Questionnaires, interviews and mathematics achievement test were used to collect information from the students. Data analysis involved the use of both descriptive and inferential statistics. Descriptive statistics involved means and standard deviations and the inferential statistics involved an Analysis of variance (ANOVA). The results of the study showed that computer based instructional medium was superior to the conventional methods as regards the students' achievements in mathematics, motivation and attitudes towards the mathematics course. The results lead to the conclusion that CBI is an effective teaching method which mathematics teachers should be encouraged to use for mastery of learning.

(Key words: Computer; Mathematics; Instruction)

Introduction

The formidable problem currently facing mathematics education in Kenya is the need to improve the student's performance in mathematics. Mathematics is regarded by most people as essential and its usefulness range from social, aesthetic, utility and communication. Mathematics plays a pivotal role in providing a means of studying other disciplines such as sciences, technology, geography and economics. Mathematics provides a basic relevant skill in studying other subjects without which we may have problems. The mathematics syllabi, clearly state that a mathematics course is designed to enable the learners to acquire attitudes and knowledge that will be relevant to his/her life after school. It also aims at fostering a positive attitude towards appreciating the usefulness and relevance of mathematics to a modern society. Great emphasis is placed on the application to real life situations and practical approaches to the teaching and learning of the subject.

Mathematics has been pointed as a subject area that requires practice, if the objectives of teaching the subject are to be achieved. Through presenting an activity with three components (activity, technology, formalizing) we not only give students with different learning styles different ways to see a problem but also we give them the extra time they may require for learning. Time and experience in class enrich an activity: students can learn from their experiences and can connect the mathematics to those experiences. Such a foundation helps them to understand and appreciate mathematics. There is need for manipulative equipments as useful tools in mathematics instruction. They are useful in learning new mathematical concepts and help students see the origin of the numbers in the formulas (Vanessa B. Stuart). Stuart stated that;

> Williams (1988, 101) paraphrased a Chinese proverb. 'Tell me mathematics and I forget; show me mathematics and I may remember; involve me----- and I will understand mathematics, I will be less likely to have mathematics anxiety. And if I become a teacher of mathematics, I can thus begin a cycle that will produce less mathematics anxious students for generations to come.

Our classrooms are often composed of students from different backgrounds, with different levels of motivation and are also of a wide ability range. This poses challenges to the teacher and calls for a variety of methods and approaches to teaching, which incorporate a variety of resources.

Most mathematics lessons are considered to be barren and boring by many students. The mathematics taught is considered abstract and learning is seen in terms of memorizing facts, algorithms, procedures and formulae ready for reproduction during examination time. The teaching method is basically talk and chalk and there is no effort to involve practical activities to engage and enhance students' understanding. This is a teacher centered approach where emphasis is on teaching at the expense of learning. At the end of most mathematics lessons, few students understand what was taught, some understand some of what was taught while the majority often have very little understanding of what was taught.

Learning by rote commonly associated with conventional/Traditional teaching cannot prepare children adequately for the standards required in information driven society. The conventional method is the predominant mode of instruction in primary and secondary schools (Gagne; 1975).Despite its predominance, the method has draw backs. The method provides more information than can be handled by learners in a given time, encourages learner memorization, passiveness and declining attention, lacks in individualization of instruction, and provides for limited learner- learner and learner- teacher interaction (Weir, 1989; Makau ; 1990 and Konana; 1995).Traditional/conventional methods of instruction has been cited as contributing to poor learning and consequent poor performance of students in examinations (Kanguru, 1986; Konana, 1995; Mbuthia, 1996; Too, 1996; Bii, 2001).

The use of Computer Based Instruction is perceived to enhance students understanding of mathematical concepts. The computer can be a good instrument in fostering creativity in students, as instrumentally assisting teachers to effectively teach in a more successful manner and can improve student interpersonal relationships. Computers can play a vital role in making the subject matter real, dynamic, and engaging for students. They can offer students a collaborative environment and the opportunity to explore and try out alternatives. Computers can receive and present information in a variety of forms (text, graphs, pictorial representations etc) and can allow users to manipulate the information in a variety of ways. They can also provide a positive and enjoyable working/learning environment, in which interaction and discussion are permitted. (Dalton et.al. 1989; Kulik and Kulik, 1987; Mevarech et.al.1987; Mubichakani, 2012; Mwei et.al., 2012; Yeuh and Allessi, 1988,).

The use of computers in individualized instruction is lauded due to the capacity to control the large chunks of information and to make it possible for the individual learner to learn at their own pace, view learning as fun rather than an intimidating exercise, control their learning and repeat the program on request. The manner in which the learning environment is organized is critically important because learners might not learn all that is taught in a single exposure to teaching (using conventional methods of instruction). But the need to create conducive learning environment and to employ effective approaches is inevitable, if learners' motivation and interests are to be sustained (Simpson and Oliver, 1990). This might entail the planning of activities, which may involve the use of interactive multimedia to support collaborative groupings that are likely to encourage each learner to interact directly with materials (Gavora and Hannafin, 1995). It is highly probable that the latest development of new information technology might bring about group oriented learning environment that can meet the need of large class (Ellington & Race P., 1993; Gagne et al., 1992; Johnson and Johnson, 1985, 1991; Lechlerg, 1991; Kennedy, 1995).

Mathematics is pointed as a subject area that needs a different approach rather than the conventional method of instruction. It is not that students are completely ignorant about the mathematical concepts; their ideas very often may be enormous or inadequate. Therefore, if mathematics teachers are to improve students' cognitive and affective abilities in mathematics, they must find out conceptual understanding held by CBI (Computer Based Instruction). Currently the problem to augment teaching with the available technological resources can no longer be ignored.

Therefore it is against this backdrop that the study reported in this paper sought to investigate and compare the effectiveness of CBI versus the conventional methods of instruction on students' attitudes, motivation and achievement in mathematics.

Purpose and Objectives of the Study

The purpose of this study was to determine and compare the effectiveness of CBI versus conventional methods of instruction on students' attitudes, motivation, and achievement in the teaching and learning of mathematics. In a nutshell, the study finds out that there are significant differences in students' attitudes and motivation towards mathematical course when subjected to the CBI on one hand and the conventional methods on the other

Hypotheses

The following two null hypotheses were posited for testing at an alpha level of 0.05 significance.

1. There is no significant difference in the attitudes and motivation towards mathematics course between students taught through CBI and those taught by the conventional methods of instruction.
2. There is no significant difference in the achievement in mathematics between students taught by CBI and those taught by conventional methods of instruction.

METHODOLOGY

Research Design

Quasi- experimental and qualitative research designs were used in this study. The experimental design chosen for this study was the Solomon Four Fold design which is considered rigorous enough for the experimental and quasi-experimental studies (Ogunniyi, 1992; Ary et, al., 1982; Cook & Campbell, 1979). In this study, there was a pre-test treatment and post-test to counter the limitations associated with the design. Four groups were randomly selected from the total group of 240 subjects that was available for the experiment. From the four groups, two treatment and two control groups were assigned. One treatment group and one control group were pre-tested, but all groups were post-tested as shown in table 1 below.

Table 1: A Paradigm of the Study Design
SOLOMON (1949) FOUR-FOLD DESIGN

Group	Pretest	Treatment	Post test
E1	O1	X	O2
C1	O3		O4
E2		X	O5
C2			O6

<u>Key</u>
E1- experimental group 1; E2- experimental group 2; C1- control group 1; C2- control group 2
O1. O3- pre-test; O2, O4, O5, O6- posttest; X- Treatment

The qualitative design was adopted to carry out-group and individual interviews to unravel meanings that the students attach to classroom interactions and/or experiences with the instructional material particularly the CBI programme (Bogdan and Biklen, 1982; Connelly and Clandinin, 1990; Marshall and Rossman, 1989; Miles and Hubberman, 1984). As stipulated by qualitative research design (Denzin, 1989, Lincoln and Guba, 1985), the researcher/research assistants further probed the group of selected subjects to garner their views about how the instructional programs fit in with their learning and instructional needs. Also the researcher/research assistants noted responses and remarks, queried a selected group of subjects to garner their experiences with the computer in addition to the conventional methods commonly used in instruction by their teachers.

The Study Area

The study was conducted in some selected secondary schools in Bungoma County, which is located in western province of the Republic of Kenya. Bungoma County was found appropriate for this study partly because of students' poor performance in mathematics in the Kenya national examinations for secondary schools (KCSE). Mathematics has been identified as a subject that is performed poorly in the district. The formidable problem currently facing mathematics education in the district is the need to improve students' performance in mathematics. The dominant mode of instruction is conventional and this calls for the need to explore the instructional potential of CBI in the several schools, which have adopted the use of computers in the district.

Sample and Sampling Procedures

A total of 240 form three students were randomly assigned to the experimental and control groups. The two groups were handled differently due to fixed and separate tasks assigned to them. The experimental Groups (E1, E2) were selected from four schools and comprised of 120 students randomly selected from the target population. The remaining 120 were selected from the other four schools which formed the control Groups (C1, C2). One experimental and one of the control groups were pre-tested. All the 240 subjects were exposed to same content of the mathematics course on the topic of the probability taught in 22 lessons for a duration of four weeks i.e. six 40 - minutes lessons per week. The experimental treatment groups were exposed to CBI while the teacher taught the other group conventionally.

Instruments

Questionnaires, instructional software, achievement test and an interview schedule were used to collect information from the students. The scores were used to compare the groups taught using the computer based instruction (CBI) and those taught conventionally.

Data Collection and Analysis

The data obtained from the study were analyzed in terms of quantitative and qualitative descriptions. Descriptive statistics consisted of percentages, means and standard deviations. Inferential statistics used included analysis variances (ANOVA), which were employed to determine the significance of the differences in students' attitudes, motivation and achievement in mathematics. In addition, the quantitative analysis was supplemented by qualitative descriptions to provide a fuller picture of the findings particularly in those areas that are not easily amenable to quantification.

Results

An examination of Table 2 indicates low mean scores and standard deviations for both **experimental group (E1) and control group (C1) on all test measures. The test measures included the Students Motivation Questionnaire (SMQ), Student Attitudes Questionnaire (SAQ) and the Mathematics Achievement Test (MAT).**

Table 2 Comparison of mean scores and the standard deviations (S.D.) of the pre-test scores of the E1 and C1 groups on the SMQ, SAQ, and MAT.

SCALE	GROUP E1 MEAN	GROUP E1 S.D.	GROUP C1 MEAN	GROUP C1 S.D.
SMQ	51.67	16.12	51.02	15.99
SAQ	44.82	14.68	44.24	14.63
MAT	29.92	11.98	29.41	8.42

An Analysis of Variance (ANOVA) at 0.05 level of significance revealed no significant differences in the attitudes, motivation and achievement capabilities between the experimental (E1) and control (C1) groups (homogeneity). As shown in Table 2, F- values less than the critical value are indicative of the non existence of significant difference between the scores of the groups. The scores are statistically not significant.

Table 3 Analysis of Variance (ANOVA) of the pre-test scores on the SMQ, SAQ, and MAT.

SCALE	F-RATIO	CRITICAL VALUE
SMQ	2.89	3.07 (ns)
SAQ	0.75	3.07 (ns)
MAT	0.06	3.07 (ns)

ns- not significant at $p< 0.05$ level.

Table 4 **shows the** posttest mean scores and standard deviations of the subjects on **the student's attitudes and motivation questionnaires and on the mathematics achievement test respectively**. An examination of Table 4 reveals that: 1) overall mean gain of the entire sample on SMQ, SAQ and MAT respectively is [8.32, 4.58 and 30.04]: 2).the mean gains of the subjects in the E1 and C1 are [12.42, 9.31 and 36.50] & [8.10, 1.13 and 24.09] respectively. Apparently, the mean scores of the subjects in the experimental groups are higher than the overall mean score of the entire sample and higher than the mean scores of the control groups. This indicates that the subjects in the **computer based instruction** (CBI) treatment groups scored higher than the control groups on the tests.

Table 4: Mean scores, standard deviations, and mean gains of the subjects on the posttest of the SMQ, SAQ and MAT tests.

SCALE		OVERALLN=240	E1	E2	C1	C2
POSTTEST MEAN	SMQ.	59.67	64.08	61.33	59.12	54.13
	SAQ	49.11	54.12	51.67	45.37	45.28
	MAT	59.71	65.42	65.33	53.50	52.58
S.D.	SMQ.	15.91	21.03	23.58	16.12	22.87
	SAQ	16.55	17.01	16.21	16.54	16.42
	MAT	6.86	8.17	7.24	5.35	6.68
MEAN GAIN	SMQ.	8.32	12.42		8.10	
	SAQ	4.58	9.31		1.13	
	MAT	30.04	36.50		24.09	

An Analysis of Variance (ANOVA) performed on the mean scores of the posttest scores reveal that there was significant differences in the post test mean scores between the experimental groups and the control groups. An examination of Table 5 indicates that the F-ratio is statistically significant because the F-values (F= 5.07, 4.10 and 67.48) exceed the corresponding critical values of (0.43, 0.52 and 0.57) of the variables attitude, motivation and achievement in mathematics needed to reject the hypotheses in question. This is a clear indication that the posttest scores obtained by the subjects are statistically different.

Table 5: Analysis of Variance (ANOVA) of the post-test scores on the SMQ, SAQ, and MAT

SCALE	F-RATIO	CRITICAL VALUE
SMQ	5.07	0.43 (s)
SAQ	4.10	0.52 (s)
MAT	67.78	0.57 (s)

s- Significant at $p < 0.05$ level.

During the interview, the subjects were requested to write five sentences describing their experiences with the two modes of instruction. Results of the data triangulated in terms of the four motivational variables (after Keller & Suzuki, 1988; Malone, 1981) and converted into percentages.

Data from the interviews indicates that 75% of the subjects in the E1 group and 73% of the subjects in E2 group were encouraged by the course and applied the knowledge acquired compared to only 42% and 45% in the C1 and C2 groups respectively. Twice as many subjects in both the E1 and E2 groups i.e. (88% & 84% respectively) compared to only 44% and 42% in the C1 and C2 groups respectively felt that the content information taught was satisfactory and not too easy, difficult or unclear. The results further showed that 76% and 80% respectively in the E1& E2 groups concurred that the mathematics lessons were attractive, challenging and full of fun compared to only 38% & 42% in control groups C1 and C2. Lastly, 74% & 71% in the E1 and E2 respectively against 30% and 34% in the control groups reckoned that the information provided was relevant to their future. In other words, the CBI programme has a higher marked effect on the subjects' motivation towards the mathematics course than the CMI.

Discussion of Findings

Students' attitudes and motivation towards mathematics

The foregoing findings indicate that the null hypothesis one (H_{01}) in respect of the students' attitudes and motivation towards the mathematics course was rejected. According to the available data, there was a significant difference in the performance on the SAQ and SMQ between the experimental groups (E1 & E2) and the control groups (C1 & C2) in favour of the former. The evidence at hand therefore, suggests that the students who were taught mathematics concepts on the topic of probability using the computer based instructional medium approach achieved higher motivation and showed a more positive attitude towards the mathematics course than those taught using the conventional methods.

Students' Achievement in mathematics

These results in the schools under review show existence of significant differences in achievement between the control and the experimental groups. The available data from this case was inconsistent with the expectations of the null hypothesis. In effect, this hypothesis was rejected. Unlike the mean scores of the two CBI treatment groups (E1 and E2), the mean scores of the control groups (C1 and C2) were significantly different from those of the former with respect to the mathematics achievement test (MAT) as shown on page (97). The experimental groups exhibited a higher rate of general learning (achievement) than the control groups.

On the basis of these findings, it is advanced that the use of CBI programme in, mathematics was probably the factor influencing the student's level of general learning. These findings provide empirical evidence and basis for concluding that the use of a computer programmed instructional medium such as CBI text facilitates higher level of learning in mathematics.

The implication from the above interpretation, suggests that the level of achievement in learning of mathematical concepts of probability, is marked higher when the students are taught using the computer based instructional medium (CBI) than when the conventional method is employed. Among the studies in support of the findings of this study are those by Dalton et.al. 1989; Kulik and Kulik, 1987; Mevarech et.al.1987; Mubichakani, 2012; Mwei et.al., 2012;Yeuh and Allessi, 1988,) who maintain that, effective learning is more assured through a computer programmed instruction medium approach i.e. CBI than with the conventional instructional approach.

Further, it can be concluded from these findings that, the addition of media such as computer programmed texts to lectures, discussions, and demonstrations in the teaching and learning of **mathematical concepts** is likely to enhance students' achievement in the **subject**. In general, the findings of this study are in accord with the views expressed in the aforementioned studies.

Conclusions

The central object of the study was to investigate the effectiveness of CB1 and CM1 on the students' attitudes, motivation, and achievement in the teaching of mathematics at the secondary school level. The two (CM1 and CB1) instructional methods were employed on the undertaking of the same tasks. The data derived from these two modes of instruction were compared to determine which method was more effective in the amount of students' achievement, attitudes and motivation towards the mathematics course.

In respect to research questions about whether there would be any significant differences between achievement, attitudes and motivation towards the mathematics course of the students exposed to the CBI and those taught by CMI, the findings of this study on all the dependent measures are in the affirmative. Specifically, the inferential statistics revealed that the difference between the mean scores obtained by the subjects in the CBI treatment groups (E1 & E2) and those of the control groups (C1 & C2) on all the dependent measures were statistically significant.

The use of CB1 system in this study has demonstrated a great potential to promote cognitive, affective and psychomotor skills of Form III secondary school students in the mathematics topic of probability. Apparently, two major advantages stand out from this finding. The first is that the problem of the concept of probability being a difficult topic to teach by conventional methods, may be resolved by the use of a CB1 programme that emphasizes collaborative learning, creativity, self-paced and individual learning. The second is that the declining performance and students' interest in mathematics (stated in the background as the formidable problem currently facing mathematics education at the secondary school level in Kenya) may be arrested by the use of CB1.

The effectiveness of the CB1 in promoting collaborative learning may form part of the solution to the emergence of large classes in the context of inadequate human and material resources. This finding indicates that the CB1 system has a potential for encouraging student participation in mathematics lessons and problem solving activities. Besides, there are several instances where the use of CB1 provided the teacher more leeway to attend to individual students needs and to supervise students work. It seems that a well-designed CB1 could promote a more conducive learning environment and enhance the development of cognitive, affective and social skill gains.

As to whether the conventional methods of instruction can really help students achieve the practical skills or ability to solve problems, the findings of this study indicate that this method is inferior when compared with computer based instructional medium approach in the amount of learning achieved and on students' attitudes and motivation towards mathematics course.

The findings of this study suggest that the teaching of the mathematics course require the use of a computer programmed text, envisaged as not only capable of illustrating the points of interest but also proficient in arousing motivation and raising questions as pointed by Komen (1991). Instructional media is also credited with the power to direct learners' attention to the subject content as advanced by Gagne (1975) to enter into an experience that is memorable as espoused by Kariingithi (1988), to help learners to understand and remember what they read as postulated by Romiszowski (1988) and Farrant (1992). It is probable that the idea of operating the CB1 may have given learners the impression of learning by doing. Learning by doing is a well-attested learning strategy in mathematics (Gerdes 1986, Keitel, 1986).

On the basis of these findings, the researcher advocates that, **since students, like all other human beings have a limit to which they can grasp, perceive, conceptualize, and apply what is orally or visually presented to them**, then it is imperative that, the learning of mathematical concepts be presented to a learner with texts that are programmed via the computer system.

Recommendations

Based on the findings of this study, the researcher recommends the following:

1. That whenever the matter at hand requires positive students attitude towards the subject (mathematics) and a high level of motivation for effective learning, then the teacher should embrace the use of computer based instructional programs in their lessons.
2. Mathematics teachers should make every effort to produce or obtain appropriate and well-articulated computer programmed instructional materials and use them in their lessons.
3. The ministry of education should embark on a serious campaign through its various arms, to enable teachers understand and appreciate that the teaching of mathematics would be greatly enhanced in the event they use CBI. Any teacher with the desire to improve students' attitudes, motivation and achievement in mathematics should be sensitized on the use of CBI in mathematics.

REFERENCES

Ary, D., Jacobs, L. C., & Razavieh, A. (1982). *Introduction to research in education*. New York: Holt, Rinehart and Winston.

Atkinson, R. and R. Shiffrin (1968) Human Memory: 'A proposal system and its central processes'. In: K. Spence and J. Spence (Eds). *The psychology of learning and motivation, Vol.2 New York: Academic press.*

Bangert-Drowns, R. L., Kullik & Kullik, C. L. C. (1985), Effectiveness of Computer Based Education in Secondary Schools. *Journal of Computer-Based instruction*, 12, 59-68.

Campbell, D. T., & Stanley, J.C. (1966). *Experimental and quasi- experimental designs forresearch*. Chicago: Rand McNally.

Cohen, L, and L. Manion (1994) (fourth edn.*), Research methods in education*, London: Routledge.

Ellington, H., & Race, P. (1993). *Producing teaching materials*: A handbook for teachers and trainers.2nd ed. London: Kogan page Ltd.

Farrant, J.S. (1980). *Principles and Practice of Education*. Essex England: Longman.

Friend, J. (1985). *Classroom Uses of the Computer*: A Retrospective view with implications for developing countries. Washington: World Bank.

Ford, D. M. (2007). Technologizing Africa: On the bumpy information highway. *Computers and Composition* , 302-316.

Fraenkel, J., & Warren, N. (2000). *How to Design and Evaluate Research in Education.*New York: McGraw Hill.

Gagne, R.M., Briggs, L. J., & Wager, W. W. (1992).*Principles of instructional design.* 4th ed. Forthwork, Texas: Harcot Brace Javanovick publishers.

Gakuru, O. N. and P. W. Kariuki (1986) "*Computers in education at Aga khan academy*. A *study of the impact of the information*", Nairobi, Kenya.

Gavora, M. J. & Hannafin, M. J. (1995) Perspectives on the Design of Human- Computer Interactions: Issues and implications. *Instructional science, 22, 445-447.*

Hawridge, Jaworski and McMahon (1990), *computers in third-world countries*. London: The McMillan press Ltd.

James, H. (2009, September 23). *Microsoft Corp.* Retrieved October 4, 2009, from Microsoft Corp. web site: http://www.microsoft.com/presspass/contactpr.mspx

Johnson, D. W., & Johnson, R. T. (1985). Cooperative learning: One key to keep computer assisted learning. ***The** Computing Teacher, 13 (2), 11-15.*

Johnson, D. W., & Johnson, R. T. (1991). *Learning together and alone*. Englewood cliff, N J: Prentice hall.

Kanguru, K. K. (1986). *Factors Contributing to Poor Performance in Physical Sciences*: A Study of Selected Schools in Busia District. M. ed. Research Project Kenyatta University.

Kariingithi G. G. (1988). *A Survey of Teaching aids used by Teachers in Teaching Home Sciencein Primary Schools in Northern Division of Nairobi District.*

Unpublished M.Ed./PTE Thesis, Kenyatta University.

Kennedy,I. M. (1995). *Cooperative learning and computers*: Understanding the partnership. In P. M. Alexander (ed.), Computer assisted education and training in developing countries. Pretoria: University of southern Africa.

Kenya, Republic of (1988). *Education and Manpower Training for the next Decade and Beyond*. Nairobi: The Government of Kenya.

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

Konana, L. S. (1995).*Education, Science and Technology*. Paper to Pan African Colloquim, Moi University, 21st February 1995.

Koul, L. (1992). *Methodology of Educational Research*, 2nd Edition. New Delhi: Vikas Publishing House Development Ltd.

Kulik, J. E., & Kulik, C. L. (1987). *Computer-Based Instruction: What 200 evaluations say*.
Paper presented at the annual Convention of the Association for Educational Communications and Technology, Atlanta, Georgia.

Kulik, J. E., & Kulik,C. L. (1991). Effectiveness of computer- based instruction: An updated analysis. *Computers in human behavior. 7 (1-2), 75-94.*

Makau, B. M.(1990) *Computers in Kenya's secondary schools. Case study of an innovation in education*, International development Research Centre (IDRC), Canada.

Mbuthia F. K. (1996). *A Comparative Study of the Effects of Two Instructional Approaches on Student Performance in Kiswahili Poetry in Selected Secondary Schools in Eldoret municipality*. Unpublished M. Phil. Thesis, Moi University.

Mevarech, Z., Stern,D. & Levita, I. (1987).To cooperate or not to cooperate in CBI: That is the question. *Journal of Educational Research, 80 (3), 164-168.*

Miles, M. B. & Huberman, A.M. (1984). *Qualitative Data Analysis*. London: Sage.

Ogunniyi, M. B. (1996). Science, Technology and Mathematics: The Problem of developing critical human capital in Africa in Africa. *International Journal of science education, 18 (3), 267-284.*

MoEST. (2004). Meeting the Challenges of Education, Training and Research in Kenya in the 21st Century. *Kenya Sessional Paper.* , 67-70.

Mondoh, H. (2005). *Methods of Teaching Mathematics: A Handbook for Teachers and Students.*Njoro, Kenya: EgertonUniversity Press.

Mubichakani, J. M., (2012). *Effect of Computer Based Learning in Mathematics on Learners Motivation and Achievement Level in Relation to Gender in Bungoma North District, Kenya.* Unpublished MPhil Thesis, Moi University.

Mwei, k. p., Too, K. J., & Wando, D. (2012). *Effect of Computer Assisted Instruction on Student's Attitudes and Achievement in Matrices and Transformation in Secondary Schools in Uasin Gishu District, Kenya*: Moi University, Kenya.

NCAPD. (2005). *Bungoma District Strategic Plan 2005 - 2010.*Nairobi: Unpublished.

Republic of Kenya, (1997), *Bungoma district development plans 1997-2001* Nairobi: Government printers.

Romiszowski, A. J. (1988). *The selection and use of instructional media for improvedclassroom teaching and interactive*. Individualized instruction. Kogan Page Ltd.: London.

Too J. K. (1996). *A Survey of the Availability and Use of Media Resources in Mathematics Instruction*: The Case of Secondary Schools in Nandi District, Kenya. Unpublished Masters Thesis, Moi University.

Weir, S. (1989). *The Computer in Schools*: Machine as Humanizer. Harvard Educational Review, 59 (1), 61-73.

Yeuh, J. J. & Allessi, S. M. (1988). The Effects of Reward, Structure and Group Ability Compositionon Cooperative Computer- Assisted Instruction. *Journal of Computer-Based Instruction, 15, 18-22.*