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## *Full Length Research Article*

# EFFECTIVENESS OF COMPUTER-BASED INSTRUCTION: AN ANALYSIS BY GENDER

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**ABSTRACT**

This study was designed to explore the instructional potential of a Computer-Based Instruction (CBI) program in the teaching of probability concepts to form three mathematics curriculum in selected secondary schools in Kenya. Specifically, the study reported herein sought to determine whether there was a statistically significant difference by gender on students exposed to the computer based instruction in terms of the students' achievement, their perception of the learning environment, and their attitudes and motivation during the instructional process in the area of probability. This involved comparisons between the male and female students on all the dependent measures namely the Mathematics Achievements Test (MAT), the Students' Perception Questionnaire (SPQ), the Students' Attitude Questionnaire (SAQ) and the Students' Motivation Questionnaire (SMQ). The results infer that the CBI program resulted in significant learning gains, proper perception of the learning environment and lesson elements, better attitudes and motivation towards the topic on probability. This is statistically non significant based on the gender of the subjects. Moreover, the CBI program alleviated the problem of teaching probability that is considered difficult to teach and learn, and hence provides better opportunities for equal students' participation and interaction. In this regard, it is concluded that computer based interventions improve teachers skills in teaching and students understanding of concepts that have high cognitive demand irrespective of students gender. It is thus recommended that the CBI program be integrated in the teacher training curricula and instructional process in the classroom.



## INTRODUCTION

Mathematical knowledge and understanding is important not only for scientific progress and development but also for its day to day application. The fundamental role of mathematics lies in its daily application in most applied and social sciences, military, aerodynamic advancements, government, business, management studies and house hold chore (Cockroft, 1982; Mutunga and Breakel, 1992). Scopes (1973) and Mondoh (2005) concur to outline the four basic goals of teaching the subject as utilitarian, personal, economic and cultural. Therefore, mathematics in our society is training in itself, where development of new techniques and concepts must have scientific, economic and sociological consequences akin to the development needs of the society. This is partly the reason why mathematics is compulsory in the school curriculum in Kenya (Republic of Kenya, 1999). The Kenya Institute of Curriculum Development emphasizes that specific concepts and skills must be mastered by students at the secondary school level (Kenya Institute of Education (KIE), 2002).

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This includes measurement, statistics, probability, scale drawing and calculus. Such concepts and skills are useful and have wider application in other subjects like physics, chemistry, biology and geography (Kenya National Examination Council (KNEC), 2000). However, the general performance in mathematics among secondary school students in Kenya has remained poor for many years (KNEC, 2006; 2008). An analysis of the Kenya Certificate of Secondary Education (KCSE) examinations question papers and reports indicate that questions on probability keep recurring year after year yet no remarkable improvement has been realized in terms of students' performance (KNEC, 2008). This poor performance trend observed in mathematics has been attributed to many factors with poor teaching methods at the top of the ladder. This is blamed on the predominant use of teaching techniques in schools which are expository in nature (Kiboss, 2002; Ndirangu, 2000; Tanui, 2003; Too, 2007; Wanjala, 2005; Wati, 2011; Wasike, 2013; Nandwa, 2016; Wekesa, 2003). While such techniques provide more information to the learners in a given time, they encourage rote learning, passiveness and decline in attention as well as promoting lack of individualized instruction, and limited leaner–leaner and leaner–teacher interaction (Wasike, 2013;

Nndirangu *et al*, 2005). This may negatively affect the leaner's beliefs and attitudes about mathematics. Consequently, many students fail to perform well in the subject because of their inability to understand and organize material sufficiently in the time allowed for study and retention. This means that the country may not achieve the Kenya Vision 2030 and the millennium development goals, for which mathematical knowledge is necessary.

Several interventions have been made by stakeholders and development partners like the Strengthening Mathematics and Science in Secondary Education (SMASSE), the New Partnership in Africa for Development (NEPAD) and the Kenya Education Sector Support Program (KESSP). All these initiatives are aimed at improving the teaching of mathematics and science subjects. The initiatives have focused on improving the teachers' skills in teaching so that concepts that have high cognitive demand are best learned by students. Despite these initiatives, the poor performance trend has continued. Literature suggest that one problem facing the instruction process in Kenya is the need to improve students' learning outcomes in a subject that impacts poorly on students learning especially in science-based subjects (Kiboss, 1997; Ndirangu, 2000; Wekesa, 2003; Wasike, 2003; Wasike, 2013; Wanjala, 2005). It is not clear if poor performance in mathematics is related to lack of teaching resources, poor teaching strategies, and the abstractness of the mathematical concepts or other such related factors. In this regard, computer based interventions have shown great potential for those areas of science and mathematics that are difficult to teach by traditional methods or where students interest is lacking.

The Computer-Based Instruction (CBI) is an area that has been recently lauded for its capability to foster the teaching of concepts and skills that are otherwise difficult to teach using the regular techniques (Kiboss, 2002; Tanui, 2003; Wanjala, 2005; Wati, 2011; Wasike, 2013; Wekesa, 2003). The use of CBI is perceived to enhance students understanding of mathematical concepts. The computer can be a good instrument in fostering interpersonal relationships as well as creativity in students and in assisting teachers to effectively teach in a more successful manner. 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 in problem solving. A study was therefore designed to explore the instructional potential of the CBI in mathematics instructional process on the topic of probability whose objective was to investigate the effect of a computer based instruction program on students' learning outcomes on the topic of probability among Kenyan secondary schools. Specifically, the study sought to determine whether there was a statistically significant difference by gender on students exposed to the computer based instruction in terms of the students' achievement, their perception of the learning environment, and their attitudes and motivation during the instructional process in the area of probability

## MATERIALS AND METHODS

A quasi-experimental approach was employed to randomly assign 157 students in their intact class streams to two groups that were randomly selected from co-educational schools with computers. This was because schools chosen for the study could not allow intact classes to be split as this would interfere with the established ambiance of the existing class streams. Moreover, school authorities do not permit random selection of individual students to be broken up and re-constituted for research purpose once they have been assigned to a class stream.

These research procedures were put into consideration throughout the design and development of the study because of two reasons. First, the inter-subject differences were eliminated by randomly assigning the subjects to the experimental group. Secondly, the interactive effect that could occur due to the administration of the pre-test and the experimental manipulation was eliminated by intruducing another experimental group which was similar in all aspects to the first experimental group except that the pre-test treatment was controlled. Moreover, the addition of the same experimental group was used to eliminate the between-session variations that could occur between pre-test and post-tests treatments (Fraenkel and Wallen, 1998; Ogunniyi, 1992; Kiboss, 1997). To generate the required data and make comparisons between the male and female students, four dependent measures namely the Mathematics Achievements Test (MAT), the Students' Perception Questionnaire (SPQ), the Students' Attitude Questionnaire (SAQ) and the Students' Motivation Questionnaire (SMQ) were used. In developing the instruments, the existing literature on Form Three mathematics, courseware design and development, educational measurement and evaluation was consulted and several variables which are commonly used to investigate the effect of the new technology on the subjects' cognitive and affective domain were identified.

To ascertain the validity of the instruments, expert critical analysis of the test items, relevance and appropriateness of the content, and the sequencing, wording and instructions therein were assessed and improvement done. The consistency levels of the instruments were determined using Kuder-Richardson formula 21 (K-R 21). This formula was considered appropriate because it determines the reliability of an instrument by a single administration and can asses multiple response items (Kathuri and Pals, 1993). In this view, each final version of the instruments used was tested and yielded a reliability coefficient of not less than 0.75 as determined by K-R 21 formula. Accordingly, the instruments were considered suitable to make possible group predictions that are accurate enough for most purposes.

## RESULTS

The introduction of computers into the classrooms is accompanied by conflicting expectations regarding the potential effects based on gender related differences towards learning of mathematics (Linder, 1992; Ritt *et al* (1988); Tamar, 1994). As such, it was useful to examine the extent to which gender affects the students' learning outcomes in terms of achievement, perception of the mathematics learning environment, attitude development and motivation towards the learning of probability. In this respect, the post-test mean scores obtained by the boys and girls exposed to the CBI program on the MAT, SPQ, SMQ and SAQ were compared to ascertain whether gender differences existed. The results are tabulated in the following Table. The results presented in Table 1 reveal that boys' and girl's achievement, perception of the classroom learning environment, their attitude and motivation towards the probability lessons were similar on all

the measures. However, these results do not show if there is any significant difference. As such a further analysis using an Analysis of Variance (ANOVA) test was performed and results reported in the subsequent tables.

**Table 1. Post-test Mean Scores of MAT, SAQ, SMQ and SPQ by Gender**

| TEST | Male (N = 82) | | Female ( N = 75) | |
|---|---|---|---|---|
| | Mean | S.D | Mean | S.D |
| MAT | 66.68a | 10.78 | 65.42a | 10.4 |
| SAQ | 72.82b | 10.68 | 72.24b | 10.63 |
| SPQ | 77.45c | 10.98 | 77.50c | 10.42 |
| SMQ | 77.25d | 10.12 | 77.98d | 10.99 |

a,b,c,d respectively are identical

**Table 2. ANOVA Results of the Post-test Scores on MAT by Gender**

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between Groups | 2-1=1 | 5.29 | 5.29 | 0.30ns |
| Within Groups | 157-2=155 | 2743.40 | 17.70 | |
| Total | 156 | 2748.69 | 22.99 | |

**Table 3. ANOVA of the Post-test Scores of the SPQ by Gender**

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between Groups | 2-1=1 | 40.29 | 40.29 | 0.08ns |
| Within Groups | 157-2=155 | 7476.40 | 52.08 | |
| Total | 156 | 8112.69 | 92.37 | |

**Table 4. ANOVA of the Post-test Scores of the SAQ by Gender**

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between Groups | 2-1=1 | 2.29 | 2.29 | 0.03ns |
| Within Groups | 157-2=155 | 9231.0 | 79.56 | |
| Total | 156 | 9234.29 | 82.05 | |

**Table 5. ANOVA of the Post-test Scores of the SMQ by Gender**

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between Groups | 2-1=1 | 32.29 | 32.29 | 0.28ns |
| Within Groups | 157-2=155 | 8827.25 | 56.95 | |
| Total | 156 | 8859.54 | 89.24 | |

The results shown in Tables 2 - 5 reveal that the mean scores of the boys and girls do not differ significantly at $\alpha = 0.05$ level since all the F ratios are less than the critical value. This indicates that the subjects' gender had no statistically significant influence on the subjects' performance on the MAT, SPQ, SMQ and SAQ. Therefore it has been established that the improved understanding of probability, positive attitudes and motivation during the lessons, and appropriate perception of the classroom environment is attributed to the CBI instructional conditions and not to gender.

## DISCUSSION

The foregoing presentation shed light on the themes that were investigated in this study on the effect of the CBI program on students' perception of the classroom environment, interaction patterns and their attitudes and motivation. The implication from the above results and interpretation suggests that the CB1 exerted a more positive influence on the subjects' attitudes and motivation towards the mathematics course. In support of these findings are earlier discussions by Kulik and Kulik (1991), Voogt (1993), Bangert-Drowns *et al* (1990), Beichner (1994), Riddle (1995), Kiboss (1997, 2002), Wati (2011), Wanjala (2005), and Wekesa (2003).These studies confirm that students demonstrate a more favorable attitude towards learning mathematics and are highly motivated through CB1 than when taught using the conventional instructional methods. In general, the findings of this study are in agreement with the views expressed in the aforementioned studies. It is clear that the results are in agreement with the earlier findings showing that the use of computers promotes positive students' attitudes and motivation. This is because computers are capable of providing opportunities for the learners to experience the thrill of chasing after the knowledge they really want. From the results on analysis of gender effects, it can be concluded that the improved positive attitude and perception was related to the CBI instructional conditions and not to gender. These findings lend support to the view that the students' achievement, attitudes and perception of science learning depend mainly on the teaching approaches used (Linder, 1992; Olugbemiro, 1991; Yalcinalp *et al*, 1995; Kiboss, 1997; Kiboss *et al*, 2004). Moreover, positive attitudes towards computer use in science education are linked more to the type of activities or task students are involved in than in any inherent gender related abilities (Yalcinalp,Geban and Ozkan, 1995).

Studies investigating the effect of CBI on male and female students have also been done. In contrast, Roblyer, Castine and King (1988) reveal that CBI slightly favours boys over girls with differences falling short of statistical significance. Closely related to the above is a study using CBI for teaching mole concept in chemistry in which no significant difference was found between sexes (Yalcinalp *et al*, 1995). A similar conclusion was arrived at in a study to investigate the relative effect of CBI on students' learning of the physics concept on measurement (Kiboss, 1997, 2000). Clark *et al* (1991) in their study observed that though girls and women showed initial hesitation, they became very pragmatic and confident users of computers with experience. Further support is by Burgo meta-analysis that indicates comparable results on post-treatment tests for boys and girls. Similarly, Kirkpatrick and Cuban (1998) and Anderson (1999) noted similar achievement scores when boys and girls had experienced a similar amount of time and type of computer experiences. However, girls were expected to achieve more when they worked collaboratively in small groups as they preferred to explore problems verbally (Harding, 1997; Mondoh, 2000). This study has shown the interactiveness of the lesson components. Contrary to earlier studies in Kenya which indicates that some students have greater interaction with their teachers than others do (Sanga, 1982), the findings of this study have placed all students in the classroom irrespective of their gender on an equal opportunity to participate fully in the lessons. This is in line with KNEC reports (2006, 2008), Ministry of Education (2001) and Ministry of Education (1993) who have made similar suggestions by advising teachers to simplify complex concepts for students to comprehend.

### Conclusion

The pace of technological advancement in the world in general and in educational setting in particular is on the increase. In Kenya, the government is embracing technology as seen in its vision 2030. The Ministry of Education has embarked on the infrastructural development in schools in readiness to embracing technology in the instructional process. The findings of this study provide a starting point and part of the

database in this direction. Specifically, the study recommends that teacher training programs should be restructured so as to incorporate computer studies in order to enable teachers to use CBI technology. This ought to be integrated in the curriculum especially in mathematics instruction so as to facilitate educational reforms and change the teachers' position in instructional practices from that of a dispenser of knowledge to a facilitator. The general performance in mathematics among secondary school students in Kenya has been poor for many years. The findings of this study reveal that the use of computer based instructional program enhances higher ability in learning to both gender. This study recommends that mathematics teachers should make every effort to produce or obtain appropriate and well-articulated computer programmed instructional materials and use them in their lessons. The use of computer-based instruction also enhances positive students' attitude and motivation towards the mathematics course. It is therefore recommended 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.

## REFERENCES


Anderson, N. 1999. Using Higher Order Computer Tasks with Disadvantaged Students. Proceedings of the National Educational Computing Conference (NECC), Atlantic City.

Bangert-Drowns, R. L. and Kullik, C. 1990. Effectiveness of Computer Based Education in Secondary Schools. *Journal of Computer-Based instruction*, 12, 59-68.

Beichner, R. L. 1994. Multimedia editing to promote science learning. *Journal of Educational Multimedia and Hypermedia*, 3(1), 55-70.

Clark, R. and Paivio, A. 1991. Dual Coding Theory and Education. *Educational Psychological Review*, 3,445-460.

Cockcroft, W.H. 1882. Mathematics Counts: A Report of the committee into the Teaching of Mathematics in Schools. London: Her Majestys Stationery Office.

Fraenkel JR, Warren NE. 1998. How to design and evaluate research in Education, 2nd Edition McGraw-hill, New York.

Harding, J. 1997. Gender and Design and Technology Education. *The Journal of Design and Technology Education*, 2, (1)

Kathuri, N.J. 1993. Introduction to Educational Research. Egerton University: Education Media Centre.

Kenya Institute of Education. 2002. Secondary School Mathematics Syllabus. Nairobi: Government Printers.

Kenya National Examination Council [KNEC], 2000. Secondary Schools Examination Syllabus. Nairobi, KNEC.

Kenya National Examination Council [KNEC], 2006. 2005 Examination Report. Nairobi, KNEC.

Kenya National Examination Council [KNEC], 2008. 1997 Examination Report. Nairobi, KNEC.

Kiboss JK, Ndirangu M, Wekesa EW, 2004. Effectiveness of a Computer-Mediated Simulation Program in School Biology on Pupils' Learning Outcome in Cell Theory. *J. Sci. Technol.,* 1: 2.

Kiboss, J. K. 1997. Relative Effects 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 the Western Cape.

Kiboss, J.K. 2000. Teacher/pupil perspectives on Computer-augmented Physics Lessons on Measurement in Kenyan Secondary Schools. *Journal of Information Technology for Teacher Education*. 9 (2) 199-217

Kiboss, J.K. 2002. Impact of a Computer-Based Physics Instruction Program on Pupils' Understanding of Measurement Concepts and Methods associated with School Science. *Journal of Science Education and Technology,* Vol.11, No.2

Kirkpatrick, H., and Cuban, L. 1998. Should we be worried? What the research says about gender differences in access, use, attitudes and achievement with computers. Educational Technology, 38 (4).

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

Lavoie, D.R. and Good, R. 1988. The nature and use of prediction skills in biological computer simulation. Journal of Research in Science Teaching, 2 (5), 335-360.

Linder, C. 1992. Is teacher-reflected epistemology a source of conceptual difficulty in physics? International journal of science education, 14 (1), 11-121.

Ministry of Education, 1993. Project planning task group (PPTG) report. Nairobi: Government printers.

Ministry of Education, 2001. Teaching and Learning Mathematics in Primary Classromm: School-based Teacher Devlopment (SbTD). Nairobi: Ministry of Education, Science and Technology.

Mondoh, H. O. 2000. A comparison of Activities Carried Out by Boys and Girls During their free time in Relation to their Achievement in Mathematics: A case of Eldoret Municipality, Kenya. *Journal of Education and Human Resources.* (1) 1: 49-56

Mondoh, H. O. 2005. Methods of Teaching Mathhematics: A Handbook for Teachers and Students. Njoro , Egerton University Press

Mutunga, P. and Breakel, J. 1992. Mathematics Education. Nairobi: ERAP

Nandwa, M.O. 2016. INFLUENCE OF Instructional Practices on Students Achievement in Mathematics: A Case of Form Three Students of Mumias Sub-county, Kenya. Unpublished Masters Thesis, Masinde Muliro University of Science and Technology

Ndirangu, M. 2000. A study on the perception of the influence of Teaching Practice Projects on the Teaching of Science in selected secondary schools in Kenya. PhD Thesis. Egerton University.

Ndirangu, M. Kiboss, J.K and Wekesa, E.W. 2005. Reflections from a Computer Simulation program on Cell Division in Selected Kenyan Secondary Schools. The Science Education Review 4(4): 117-225.

Ogunniyi, B.M. 1992. Understanding Research in Social Science. Ibadan: University Press.

Olugbemiro, J. 1991. Computers and the learning of biological concepts: attitudes and achievement of Nigerian students. Science Education, 75( 6) 701 - 706.

Republic of Kenya, 1999. Totally Integrated Quality Education and Training. Nairobi: Government Printers.

Riddle, E. M. 1995. Communication through multimedia in an elementary classroom (Report # 143). Charlottesville: University of Virginia, Curry School of Education. (ERIC Documentation Reproduction Service No. ED384346)

Ritt, L. and Stewart B. 1996. Applying technology in the classroom, innovative strategies for teaching anatomy and physiology. *Tech Trends*, 41,(1).

Roblyer, M.D., Castine, W.H. and King, F.J. 1988. Assessing the Impact of Computer-Based Instruction. A review of Recent Research. *Computers in the Schools*, 5 (3/4)

Sanga, P.M. 1982. Ananlysis of Classroom Interaction Patterns of Kenyan Secondary School Chemistry Teachers and their Behaviors. Unpublished M.Ed. thesis, University of Nairobi.

Scopes, P.G. 1973. Mathematics in Secondary Schools. London. Cambridge University Press.

Tamar, L. 1994. Girls in Computer-Supported Science Classrooms: Perceived Classroom Climate and Attitudes towards the Learning of Science. Tel Aviv University, Israel.

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. PhD Thesis, Egerton University.

Too, K. 2007. Challenges of Teaching Mathematics in Secondary Schools in Kenya: A Case Study of Nandi and Uasin Gishu Dstricts. The Educator, 1(2) 17-26.

Voogt, J. M. 1993. Courseware for an Inquiry- Based Science Curriculum: An Implementation Perspective. Doctoral Thesis, University of Twente.

Wanjala, M.S. 2005. Effectiveness of Computer Based Instruction versus Conventional methods on Students Attitudes, Motivation and Achievement in Teaching of Mathematics in Secondary Schhols of Bungoma District. Unpublished Masters Thesis, Moi University: Eldoret.

Wasike, D.W. 2003. Effects of a Socialized Mathematical Language Modules on Students Understanding of Mathematics and their Perception of the Learning Environment. A Case of Form Two Students of Bungoma District, Kenya. M.Ed Thesis, Egerton University.

Wasike, D.W. 2013. Effects of computer Based Instruction on Secondary School Students Learning Outcomes on Mathematical Probability Concepts. Unpublished Doctoral Thesis, Masinde Muliro University of Science and Technology

Wati, H N. 2011. Effects of computer Based Instruction on Mathematics Achievement: A Case of Secondary School Students of Kakamega South District, Kenya. Unpublished Masters Thesis, Masinde Muliro University of Science and Technology

Wekesa, E. 2003. Effects of a Computer-Based Instruction Module on Students' Achievement, Perception of the Classroom Environment and Attitude Towards School Biology in Nakuru District. Kenya, Master's Thesis, Egerton University, Kenya.

Yalcinalp, S, Geban, O. and Ozkan, I. 1995. Effectiveness of using computer assisted supplementary Instruction for teaching the mole concept. *Journal of Research in Science Teaching,* 32(10), 1083- 1094

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