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Bridging Gender Disparities in Mathematics Achievement through Computer Based Learning

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Abstract
The purpose of this paper was to establish the influence of computer based learning (CBL) in Mathematics on learners' achievement level in relation to gender. Specifically, the study sought to find out if there is any significant difference in achievement between boys and girls when exposed to CBL among secondary school students in Bungoma North District, Western Province, Kenya. This study was based on the theory of situated learning which states that learning as it normally occurs is a function of the activity, context and culture in which it occurs (Lave, 1988). The study adopted an experimental design where pre-test and post-test control group was used. The target population of the study was 1,173 form three secondary school students from Bungoma North District, Kenya. Purposive sampling was used to select schools with and without computers after which simple random sampling was used to select nine schools for the study. The study used a sample size of 240 respondents. Purposive sampling was used to select students who were computer literate then simple random sampling was applied to choose the respondents of the study. Mathematics achievement tests were used to collect data from the respondents. In data analysis both descriptive and inferential statistics were used. Descriptive statistics involved means, while inferential statistics utilized independent samples t-test. It was found out that there was no significant difference between boys and girls in Mathematics achievement when exposed to CBL. The paper therefore made the following recommendations: gender digital divide to be addressed, develop and use interactive Mathematics programmes, rural electrification to be continued, teachers to be equipped with the skills and knowledge they need to use the CBL technology, computer studies to be made compulsory in secondary schools. All this recommendations aim at bringing CBL into classroom to give every student, especially girls, a competitive edge in mathematics achievement.
Keywords: Achievement, Bridging, Computer Based Learning, Gender Disparity

1. Introduction

Mathematics is one of the key subjects offered in the school curriculum across the country and is fundamental to the study of physical sciences and engineering. It is increasingly being used in medicine and biological sciences, in geography and economics, in business and management studies. It is essential to the operation of industry and commerce in both office and workshops (Mondoh, 2005). Competence could become a ticket to opportunity, careers and lifestyles. It may lead to status and power (Mondoh, 2005). However fewer girls achieve in Mathematics and majority under perform. Fewer girls than boys continue with Mathematics courses after secondary school (Mbathia, 2005). This implies that girls are being locked out of the lucrative opportunities that result from being competent in Mathematics. Mbathia noted that fewer women are in careers requiring Mathematics skills.

According to World Bank (2008) Gender insensitive teaching methodology has led to lower participation of girls as they may be ignored or discouraged by teachers. Traditionally, educational systems are likely to stream girls toward/away from certain subjects. Too (2004) in his survey of schools in north rift valley of Kenya observed that males were involved more in the different types of interactions in class than females. He further observed that teachers in schools directed more attention to boys than girls in Mathematics lessons (Too, 2004).

It is however important to note that given a generally conducive learning environment, girls can perform as well as, if not better than, boys (Eshiwani, 1993). Alternatively individualized learning should be encouraged, a learning that will give each learner, be it a girl or boy, equal chances of participation in relation to their needs, a method that will give no room to dominance of any given gender. For the first time in the history of mass education, computer as a tool can give the teacher the means of providing a learning environment for all learning styles (Vincent, 2003). Research has it that boys and girls can perform equally upon any measures of any given task when computers are used (Culley, 1988). However it remains unclear if the findings hold in Mathematics if computers are used as tools of instruction. Therefore the study sought to establish the true picture in Mathematics. The purpose of the study was to find out if there is any significant difference in achievement between boys and girls when exposed to computer based learning (CBL).

2. Review of Related Literature

2.1 Computers and Education

Computers are documented to have found their way into Kenyan education system as early as 1979 in Starehe Boys Centre (Friedland, 1985). By the year 1985 there were a number of colleges and schools which were teaching some form of computer studies as a subject (Ibid). The learning process was majorly learning about computers and not learning with computers. In 1982 Aga Khan Education Foundation funded a study that was to test the process of learning by computer. The outcomes of the pilot project as indicated by Friedland (1985) were desirable and worthy. The mode of learning, CBL, improved interactions among students. In specific subjects Friedland reports that students readily grasped abstract principles like motion in Physics.

CBL in Mathematics is effective as direct instruction when measured in terms of student achievement at all grade levels (Way & Beardon, 2003). CBL in Mathematics has been found to improve achievement among learners in different mathematics topics as follows; arithmetic (Hativa, 1991), three dimensions (Vincent, 2003) and probability (Wanjala, 2005), CBL in Mathematics may be more effective on lower ability students (Vincent, 2003). In many cases these students are weak or have low ability in analytical skills but not necessarily in problem solving or graphical skills. Such students flourish in CBL classes (Pitcher, 1992). If girls fall under this category of students then the findings imply that they will achieve better in CBL. This could be supported by an assertion that: in some ways computer can be described as gender neutral (Selwyn et al, 2001) and the several studies that indicate that there is no significant difference in girls' and boys' performance in computation work on computers (Underwood & Underwood, 1990). However this implication has not been confirmed therefore can only be hypothesized.

2.2 Gender and Computers

Gender biasness can be traced down to computer use. Men participate in computer based activities far more than women, and when women are portrayed in high technology publicity material it is often as the keyboard operator with an authoritative business-suited- man hovering around and pointing at the screen (Underwood & Underwood, 1990). In a classroom observation it was noticed that, boys dominated discussions in the computer classroom with a tendency of directing more questions to the teacher. Girls tended to sit at the back or at the sides of the room. This led to girls being disinterested, non-participating and developing computer phobia (Culley, 1988). This disparity extends to homes that have computers. It was found that only 14 percent of girls claim that computers in their homes were bought for them, whereas 85 percent of the boys say that the computers had been bought either for them or for another male in the family (Culley, 1988). Although few girls had access to home computers, most thought that they would like to have one, (Ibid).

On the other hand research also has it that there is no effect of gender difference upon any measures of task using computers. In single sex girls' schools, girls are enthusiastic about computing, as indicated by high levels of participation in computing options and in computer clubs (Culley, 1988). Other studies also indicate that girls work as effectively as boys in computing tasks like programming, electronic data base search and in simulation exercise, (Underwood & Underwood, 1990). The significant feature of these studies is that the 'no difference' results come from segregation of groups or individual testing. The testing was performed without the boys and girls mixing at group level. Therefore it's only in mixed gender pairings that the performance of girls is seen to be impoverished (Ibid). The study is after verifying this conclusion by segregating boys and girls and subjecting them to CBL in Mathematics.

3. Methodology

3.1 Area of Study

This study was conducted in selected secondary schools in Bungoma North District. This District was picked upon because there exists profound gender disparities in provision of education and attainment of education at all levels of schooling as measured by the percentage of girls in schools and their achievement in relation to that of boys (NCAPD, 2005). Bungoma North District is in Western province of the country Kenya. It borders four other districts, namely, Mt Elgon, Kitale West, Bungoma East and Lugari. It has forty three secondary schools in total.

3.2 Study Population

This study targeted 1,173 form three students of the selected schools in the Bungoma North District. Forms three were chosen upon because of their maturity and long experience in doing Mathematics. It is at form three too that achievement shift drastically among secondary school students (Eshiwani, 1987).

3.3 Sampling Procedures

Stratified, purposive and simple random samplings were used. Stratified sampling was used to select boys, girls and mixed schools. Purposive sampling was used to select schools with and without computers. Simple random sampling was used to select 3 schools for experimental group from the strata of schools with computers. Random sampling was also used to select 6 schools for control group from the strata of schools without computers. A total of 9 schools were therefore selected.

Out of the schools that were selected for the experimental study, purposive sampling was used to select students who were computer literate. This is because subjects in experimental group were required to use computers in learning. After this selection simple random sampling was used to select 40 boys and 40 girls who were used in the experimental group. The 80 students represent 20% of form three students who were computer literate. The sampling procedure is in accordance with Mugenda & Mugenda (1999) and Kothari (2003) who assert that 10-30% of the total population forms a representative sample. On the other hand, simple random sampling was used to select 40 girls and 40 boys who were used in control group I and 40 girls and 40 boys in control group II, from the 6 control schools. The numbers of subjects in control groups were determined by the number of subjects in experimental group. Below are summary tables.

Table 1. Table Used for Sampling and Showing Sample Size of Schools

Schools		Total	Selected
With computers	Boys	4	1
	Girls	2	1
	Mixed	2	1
Without computers	Boys	0	0
	Girls	8	2
	Mixed	27	4
Total		43	9

Table 2: Table Used for Sampling and Showing Sample Size of Respondents

Schools		Population	Sample Size
With computers	Boys	162	32
	Girls	179	36
	Mixed	60	12
Without computers	Boys	0	0
	Girls	280	55
	Mixed	492	115
Total		1173	240

3.4 Research Design

The pre-test post-test control group experimental design was used in the study. This allowed the researcher to control the independent variable and observe the effect of the variable on the dependent variable. In this design two groups of subjects are normally used; control group and experimental group (Mugenda & Mugenda, 1999). In this study the control group was exposed to conventional learning while the experimental group was exposed to CBL. However, since the results of this design can be influenced by the pre-test, the design was modified by adding an extra control group that was not pre-tested and hence used to assess the effect of the pre-test.

Table 3: Table of the Modified Pre-Test Post-Test Control Group Experimental Design**.**

Experimental group	Randomization	Pre-test	CBL	Post-test
Control group I	Randomization	Pre-test	Conventional learning	Post-test
Control group II	Randomization		Conventional learning	Post-test

3.5 Mathematics Achievement Test (MAT)

Mathematics Achievement Test (MAT) was use to collect data from the respondents. The MAT comprised five paper and pencil questions consisting of sixteen items. The questions were derived from Kenya Institute of Education approved Mathematics syllabus and the students' book for form three. The MAT was set by the researcher and given to professionals and experienced teachers in several schools and to lecturers in the department of Curriculum Instruction and Educational Media for standardization.

3.6 Data Collection Procedure

The researcher visited the selected schools and informed the respective principals about the study. After obtaining the principals permission, the researchers worked closely with form three Mathematics teachers. In the case of experimental group form three Computer studies teachers were also involved. The form three Mathematics and Computer studies teachers were inducted into being research assistants in charge of their respective classes. Those to handle experimental groups were taken through the probability programme by the researcher prior to the beginning of the course. Through the form three Mathematics teachers, the pre-test was administered at the beginning of the study to experimental group and control group I. The pre-test was done in an examination environment. The subjects were taken through the probability topic in duration of four weeks. The experimental group was exposed to CBL while the control groups were exposed to conventional learning. All the proceedings were being supervised by the inducted research assistants.

Subjects in experimental group were grouped into single sex groups of between three and four. Each group was allowed to discuss and learn interactively on one computer. No mixed sex groupings were allowed throughout the exercise. After the exercise a post-test was administered to experimental group, control group I and control

group II. The post- test was done in an examination setup. The researcher scored both the pre-test and post-test and the scores obtained were used to test the research hypotheses and make conclusions and recommendations.

4. Findings

4.1 Pre-Test

This study was to establish if there is any significant difference in achievement between boys and girls when exposed to CBL. It was necessary to establish the entry behaviour of all the subjects and there after ensure control of all variables till the end of the study. The entry behaviour was established through a pre-test that was administered to experimental group and control group I. Pre-test in itself is an intervening variable since it prepares the subjects for what is expected at the end of the process; it's due to this that control group II was established to check on the effect of treatment to the final score.

The scores obtained in pre test were relatively low, this could be attributed to the fact that the subjects had not learned probability topic prior to this test. The experimental male had a mean of 9.8. Experimental female had a mean of 7.1. Control I male recorded the highest mean, as compared to all other groups, of 10.5. Control I female registered a mean of 7.3.

Table 4: Pre Test Means

Sex	Mean
Experimental male	9.8
Experimental female	7.1
Control I male	10.5
Control I female	7.3

Data above indicate variability in the means obtained by the different groups. The differences in mean may or may have not been caused by chance. To avoid such speculations an independent samples t-test was carried out, at a significance level of 0.05. The following were the findings of the inferential statistic. The statistic output when comparing the experimental male and experimental female mean stationed at a p-value of 0.319 as shown in table 5. The value of 0.319 is greater than the testing point of 0.05. It implies that the difference between means of experimental group male and experimental group female is not statistically significant. Girls, before instruction, are as competent as boys in Mathematics achievement.

Table 5: T-test for Equality of Pre-test Means between Male and Female (Experimental Group)

	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Pre-Test	78	0.319	2.747	2.736

Control group I will be used as confirmation of the effect of CBL and therefore is of great importance to determine if the group shares the same characteristics as the experimental group. On comparing the means of control group I male and control group I female the t-test gave a p-value of 0.258 as shown in table 6. The p-value is more than 0.05; hence there is no statistical difference between the two means. It can be noted that the two groups, control group I and control group II share similar entry behaviours, of not having any significant difference in means of girls and boys.

Table 6: T-test for Equality of Pre-test Means between Male and Female (Control Group I)

	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Pre-Test	78	0.258	3.216	2.821

4.2 Post-Test

After learning probability a post test was administered to the three groups. Experimental group had a mean of 64.8, control group I had a mean of 49.5 and control group II had a mean of 46.8. Summary of the data is given in table 7 below. The only difference in treatment between control group I and control group II was the presence of pre test in control group I and absence of pre test in control group II. Any differences in the achievement of the two groups should therefore be explained as the influence of pre testing.

Table 7: Post Test Means at Group Level

Group	Mean
Experimental	64.8
Control I	49.5
Control II	46.8

The results with gender as a variable were as follows: Experimental male had a mean of 65.5%. Experimental female scored a mean of 64.1%. Male subjects are taking the lead but are closely followed by the female subjects. In control group I; the male emerged with a mean score of 55.2% and female had a mean of 43.8%.This is as shown in table 8. Once again the male take the first chance in this group. Contrary to the case in experimental group, females in this group are far below the males.

Table 8: Post Test Means at Sex Level

Sex	Post test Mean
Experimental male	65.5
Experimental female	64.1
Control I male	55.2
Control I female	43.8

An independent samples t-test was carried out on the data for the purposes of inferring from the data. The foremost operation was comparing the means of control group I and control group II. The objective of the operation was to determine the influence of pre testing on post test. The t-test output was 0.432 as shown in table 9. The p-value is higher than the alpha. It implies that there is no significant difference in the means of control group I and control group II. Since the only difference in encounters gone through by the two groups was the presence of pre test in control group I and absence of pre test in control group II, then it can be concluded that the presence of pre test did not influence the mean of post test in control group I. Generally it is confirmed that pre testing had no statistically significant influence on post test scores in the study.

Table 9: T-test for Equality of Post-test Means between Control Group I and Control Group II

	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Post-Test	158	0.432	2.642	3.354

The independent samples t-test carried out on the means of experimental male and experimental female gave a p-value of 0.791 as shown in table 10 below. The p-value is higher than the set alpha level of 0.05. It means that there is no significant difference in post test means of experimental male and experimental female.

Table 10: T-test for Equality of Post-test Means between Experimental Male and Experimental Female

	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Post-Test	78	0.791	1.322	4.979

Before conclusion that the CBL could be the special treatment that has enabled girls to be as competent as boys it's of necessity to test if girls in control group I have performed as good as boys. The study tested the significance in mean difference between control I male and control I female using an independent samples t-test. The t-test value was 0.021 as indicated in table 11. The p-value is less than the alpha value of 0.05. On analysis it is found out that the difference in means of control I male and control I female is statistically significant in favour of males. The males in control group I have outperformed the female. This just confirms that it is CBL that created the conducive environment that led to girls in experimental group to perform as well as the boys.

Table 11: T-test for Equality of Post-test Means between Control I Male and Control I Female

	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Post-Test	78	0.021	11.378	4.826

5. Conclusion

CBL mode of learning Mathematics is more effective on lower ability students, students who were previously perceived as 'weak' in Mathematics. In many cases these students are weak or have low ability in analytical skills but not necessarily in problem solving or graphical skills (Pitcher, 1992). Such students flourish in CBL classes. The study concludes that CBL is more effective on girls than it is on boys in regard to achievement. CBL is a process through which gender parity can be attained in Mathematics achievement. It is one method of teaching that rises above the challenges of gender insensitive teaching methods that have been reported to have rooted in Mathematics classes.

6. Recommendations

The study made the following recommendations;

- Gender digital divide should be addressed to ensure women's access to the benefits of CBL and make CBL a central tool in promotion of gender equality in mathematics achievement.
- Rural electrification be continued to reach out to all secondary schools in Kenya and work out a plan of stopping the frequent power disruptions.
- Teachers to be equipped with the skills and knowledge they need to use the CBL technology effectively.
- Computer studies to be made compulsory in secondary schools, as it is a pre requisite knowledge to CBL.
- Develop interactive Mathematics programmes on all the 68 Mathematics topics in the current secondary Mathematics syllabus.

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