

Overcoming Gender Differences in Biology Achievement through Computer-assisted Learning

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Abstract

The purpose of this paper was to investigate the gender differences in Biology achievement when instructed through computer-assisted learning (CAL) among secondary schools in Mt. Elgon sub-county in Bungoma County, Kenya. The objective of the study was to find out if there was any gender difference in Biology achievement when instructed through computer-assisted learning. The hypothesis of the study was that there was no gender differences in Biology achievement between boys and girls instructed through computer assisted learning. Quasi-experimental design entailing two group control group design where the learners were exposed to a pre-test and a post-test was adopted. The study target population included all the form three students drawn from Mt. Elgon Sub-county. Purposive sampling technique was used to identify schools equipped with computers from those without. All the 6 schools equipped with computers in the sub-county participated in the study. Simple random sampling technique was used to select 280 study respondents. A computer-assisted learning achievement test (CALAT) was used to collect data from the respondents. The data was coded and analyzed by use of inferential statistics such as independent t-test samples and descriptive statistics such as means and box plot. The study found out that there was no significant difference between boys and girls in Biology achievement instructed by CAL. However, it was established that CAL improves performance of both boys and girls. The performance of girls was almost equal the boys in the post-test. The study recommended that gender digital divide be addressed in the learning Biology and that computer studies be made compulsory in schools to enable the girl acquire the skills which they could apply during the learning process.

Key Words: Computer-assisted learning, Gender, Biology achievement.

Introduction

Biology is a branch of science that deals with the study of living organisms. Biology is primarily concerned with the nature of organisms and their relationship to each other and to their environment. The general goals of Biology Education is to equip the learner with the basic knowledge, skills and attitude that will enable one to lead an independent and useful life both to himself/herself and the larger community in which she/he lives. In many areas, biological knowledge can be applied in the general improvement of man's well-being as evidenced in Medicine, Agriculture and Industry. This is because Biology forms the basis of important disciplines such as Medicine, Veterinary, Dentistry, Agriculture and Forestry. Besides, Biology has played a very important role in providing knowledge for current biological issues such as Biotechnology, Genetic engineering, waste disposal and food production. Failure in Biology examinations means a general shortage of manpower in these Biology-related professions. Obinna (2012) noted that science educators are becoming increasingly concerned about the poor performance of students in the science subjects at both internal and external examinations. However, NCAPD (2005) found out that there existed profound gender disparities in Bungoma County in the provision of education and attainment of education goals at all levels of schooling measured by the percentage of girls' achievement in relation to that of boys. Computers are believed to have significant contributions to changes in teaching and learning practices. Research has it that boys and girls can perform equally upon any measures of any given task when computers are used (Culley, 1988). Culley further emphasized that the masculine image of the computer has deterred females from benefiting from the technology and this has made them less confident or more anxious. This has resulted in females holding more negative attitudes to computers than males. In reference to this, the study sought to find out whether use of computer-assisted learning could be used to bridge the gap in achievement among boys and girls in Biology achievement in Mt Elgon sub-county.

In this era of information technology, it is inevitable to witness technology use in educational settings. Teachers and students are supposed to be computer and Internet literate to obtain the information they need to enable them search the necessary information in and out of their classrooms. The presence of digital technologies in schools makes it possible to enhance students' understanding and exploration of biological concepts and phenomena that were previously too slow, fast, small or large (Van Rooy, 2012). Use of the computers for teaching and learning purposes in our classrooms has given rise to Computer Assisted instruction software packages. According to Anyamene, Nwokolo, Anyachebelu and Anemelu (2012), Computer Assisted Instruction (CAI) is a program of instruction or package presented as computer software for instructional purpose. Currently, it is quite necessary for the teachers of Biology to be abreast with the innovative pedagogical strategies of teaching and learning. Computers in Biology classrooms have varied uses. For instance in a general Biology laboratory for a frog dissection, simulations for anatomy class can be some examples of computer-assisted biology education (Tabin & Fraser, 1987).

Biology teachers can also use computers for literature and data retrieval, on-line control of experiments, statistical analysis, graphic summarization, simulation and modeling, decision-making, drill and practice, tutorials, test generation and administration, course management and word processing (Crovello, 1985). Other examples include increased ease and depth of learning about such dynamic phenomena as protein synthesis, predator-prey relationships, or the evaluation of effects of different insect or weed control strategies. In reference to this, CAL can allow us to teach what we already teach more easily and in greater depth.

Gender bias in science subjects has continued to generate a great deal of interest from various researchers throughout the world. Gender advocates have consistently called for the realization of gender equality within the ICT sector and for ICT diffusion that contributes to positive change in gender relations, Munyua (2006). Culley (1988) 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. Siann and Macleod, (1986) added that in mixed gender pairs the boys are socially dominant and girls are less motivated and also tend to be less successful in LOGO programming exercise. Yet various studies have indicated that girls work as effectively as boys upon computing tasks, for instance, Underwood and Underwood, (1990) in his computer simulation exercise indicated that girls work as effectively as boys in computing tasks. Other researchers; Basturk (2005), Dantala (2006), Mubichakani and Koross (2014) found no significant difference between male and female students taught, physics, history and mathematics respectively using computer-assisted instructional packages. Hence Biology teachers are expected to embrace CAL as an innovative approach to the teaching of Biology in our classes, and more so in addressing gender disparities in Biology. On this basis, this paper focused on overcoming gender differences in biology achievement through computer-assisted learning.

Purpose of the Study

The purpose of the study was to investigate the gender differences in Biology achievement when instructed through computer-assisted learning (CAL) among secondary schools in Mt. Elgon sub-county in Bungoma County, Kenya.

Research Objective

The objective of the study was to find out if there was any difference in Biology achievement between boys and girls when instructed through computer-assisted learning.

Research Question

What was the difference in Biology achievement between boys and girls when instructed through computer-assisted learning?

Research Hypothesis

There is no gender differences in Biology achievement between boys and girls instructed through computer assisted learning.

Research Methodology

Area of study

This study was carried out in Mount Elgon sub-county located in Bungoma County in the western part of Kenya, latitude 1°11'26.9664"N and longitude 34°25'11.3675"E. It borders Trans-nzoia County to the east, Bungoma west sub-county to the south and Uganda to the west. The researcher carried out study in schools in this area because they have continually performed poorly in Biology in KCSE national examinations (KNEC, 2013). In addition, NCAPD (2005) found out that there existed profound gender disparities in the provision of education and attainment of education goals at all levels of schooling measured by the percentage of girls' achievement in relation to that of boys. The study intended to explore the possibility of overcoming gender differences through CAL in national exams. The study area had a total 27 of secondary schools.

Study Population

The population which was under investigation comprised all form three Biology students in the secondary schools of Mt. Elgon sub-county. The region under study had 27 secondary schools with 1046 students of Biology. Out of the 27 secondary schools, six schools had computers and were all involved in the study.

Research Design

Quasi experimental design was used for this study where a pre-test and a post-test were administered to the respondents. Both groups were pre-tested, and post-tested, the ultimate difference being that one group consisted of male and the other group females. The researcher chose this design because it allowed her to compare the final post-test results between the two groups, giving an idea of the overall effect of the treatment.

Sampling procedures

This study employed both stratified sampling and simple random sampling techniques. In stratified sampling, researchers obtain stratified samples by dividing the population into groups called strata according to some characteristics that is important to the study, then sampling from each group, (Bluman, 2012). The samples within the strata were then randomly selected. Stratified sampling technique was used to select secondary schools which were equipped with computers. The study area has a total of 27 secondary schools, where six were equipped with computers while 21 were not equipped. The study included all the 6 secondary schools equipped with computers in the study. The region under study had 27 secondary schools with a target population of 1046 students of Biology, from which a sample of 280 respondents were selected

to participate in the study. At school level, the researcher used simple random sampling technique to select 280 respondents who participated in the study.

Sample

Simple random sampling technique was used to select 280 respondents based on Krejcie and Morgan (1970) table for determining sample size for research activities from a target population of 1046 form three Biology students.

Research Instrument

Computer-assisted learning achievement test (CALAT) was used to measure retention of Biological knowledge. The test consisted of two sections; a pre-test and a post-test each comprising of short answer questions and structured questions. The test was developed by the investigator and drawn from the form three syllabuses on the topic classification. The test was presented to the respondents by their teachers in their respective schools. The post-test was administered at the end of four weeks instruction. The scores obtained from the two test examinations were subjected to statistical analysis by use of SPSS.

Data Collection Procedure

The researcher obtained research authorization from the National Commission for Science, Technology and Innovation (NACOSTI) through the University of before proceeding to collect data in the field. The researcher then proceeded to the county commissioner's office and county director of education in Bungoma for research authorization letters. The researcher then purposively selected the schools that participated in the study, for the purpose of selecting population sample. The researcher then wrote a letter to the various school principals of the schools selected for the study to request their students and teachers take part in the study. The researcher administered students' questionnaires directly to the respondents to clarify the purpose of the study, besides seeking further clarification from teachers regarding some of the responses by the use of interview schedules. The test was administered by the Biology teachers in the various schools that were sampled for the study. Treatment was given to the experimental group; the researcher inducted all the Biology teachers in the selected schools participating in the study on how to administer the treatment to the experimental group. The researcher also developed a computer-assisted learning programme (CALP) through a power-point computer software, which was used to teach the experimental group. The control group was taught by conventional methods such as lecture method, discussion method and the question and answer method which did not involve the use of a computer. The pre-test and post-test were given at intervals of four weeks and the scores obtained were recorded for analysis.

Results

Pre-Test

The researcher administered a pre-test to both groups at the beginning of the research period. The results of the pre-test obtained were as follows:

Table 1: Gender means and standard deviations in the Pre-test

Gender	N	Mean	Std. Deviation
Male	70	55.39	11.84
Female	70	45.41	12.66

Table1 contains means and standard deviations for the pre-test scores comparing performance between males and females. The number of females who sat for the pre-test was equal to that of males. The mean score for males was 55.39 while that for females was 45.41. A box plot was drawn to visualize whether the mean scores for males/females were different.

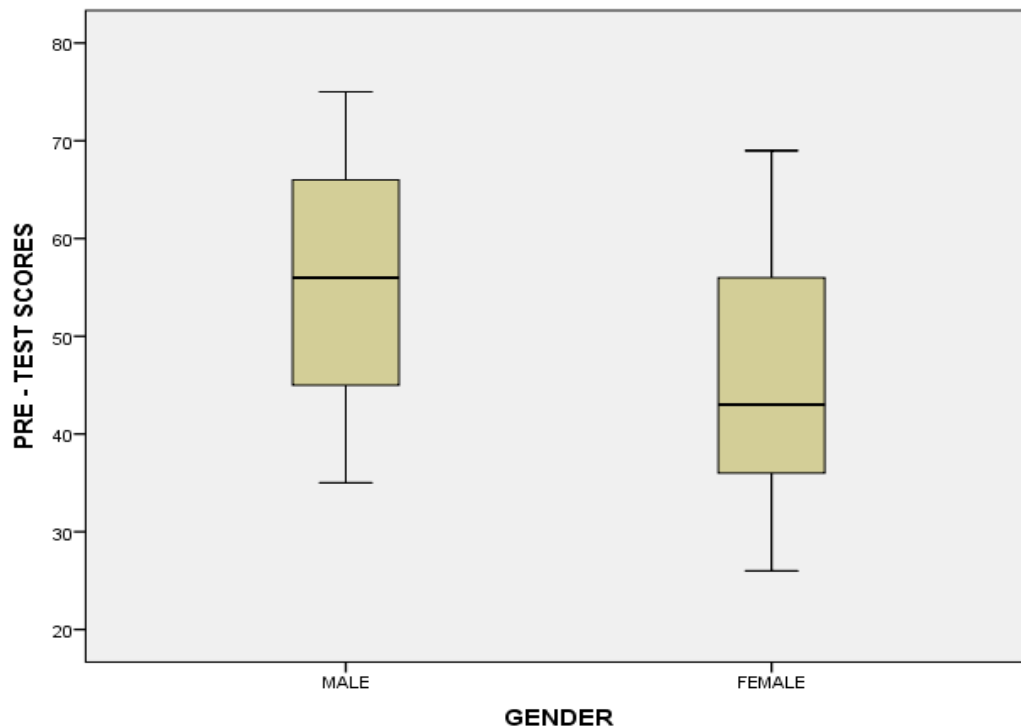


Figure 1: Gender Pre-test Scores

Figure 1 contains box plots that help in visualizing the distribution of scores for the experimental group during the pre-test comparing scores between females and males. From a glance, it could be seen that the females' and males' scores were not equally distributed. To further investigate this claim, a t-test was carried out.

Table 4.2: t-test for equality of means between Male and Female (Pre-test)

	t-test for Equality of Means						
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Pre-test Scores	4.813	138	0.000	9.971	2.072	5.875	14.068

Table 4.2 contains the results of a t-test carried out to establish the difference in means for the pre- test comparing scores between males and females. The p-value that was obtained was 0.000. Since the p-value was less than 0.05, these implied that the means were different. This meant that the females and males were of varied ability at the pre-test, the mean score for the females was lower than that of the males.

Post-Test

A post-test was administered at the end of four weeks instruction. Four weeks period between the pre-test and post-test was to ensure that the effects of the pre-test did not interfere with the results of the post-test. Two groups of students were established; 35 control males, 35 control females, 35 experimental males and 35 experimental females. All the students were first pre-tested. Then the experimental group was taught using the CAL (treatment) while the control group was taught by use of the conventional methods of teaching such as lecture method, discussion method and the question and answer method which do not involve the use of a computer. A post-test examination was administered after a period of four weeks to test the learner's retention of the knowledge learned during the experimental period. The scores obtained from the two test examinations were subjected to statistical analysis by use of SPSS version 20 and Excel computer programme. The following results were obtained after the post-test.

Table 4.3: Gender Means and Standard Deviations in the Post-test (Control Group)

Gender	N	Mean	Std. Deviation
Male	35	61.00	11.68
Female	35	53.37	14.40

Table 4.3 contains means and standard deviations for the post-test scores comparing performance between males and females. The number of females who sat for the post-test was equal that of males. The mean score for females was 61.00 while that for males was 53.37. A box plot was drawn to visualize whether the mean scores for control males and females were different.

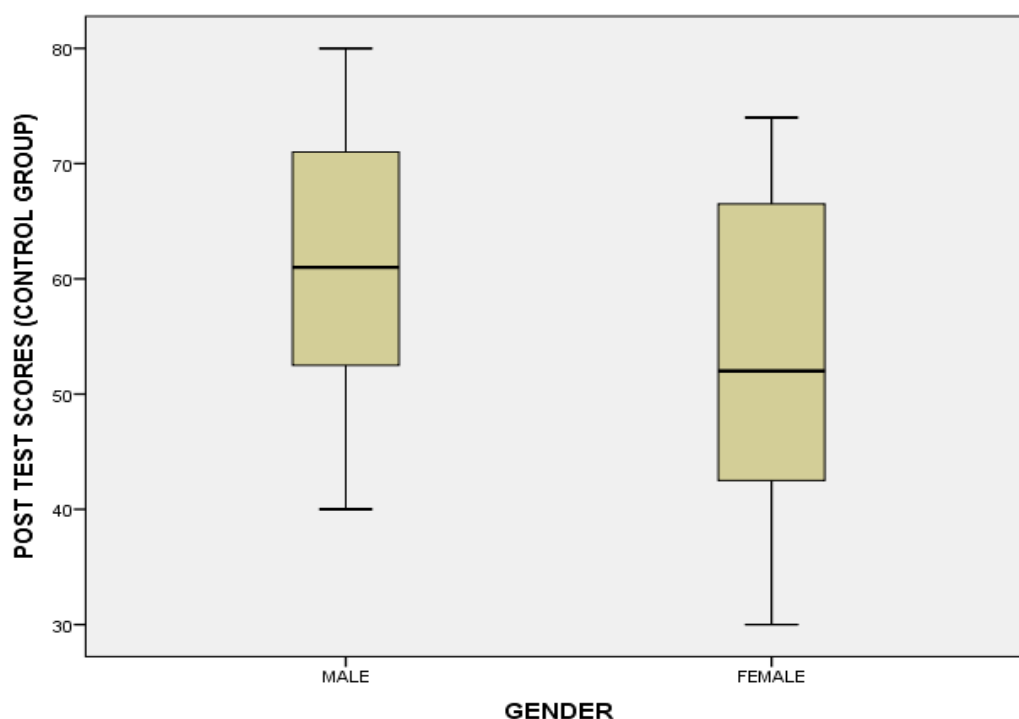


Figure 4.2: Gender Post-test Scores (Control Group)

Figure 4.2 contains boxplots that help in visualizing the distribution of scores for the experimental group during the pre-test comparing scores between females and males. From a glance, it could be seen that the females' and males' scores were not equally distributed. To further investigate this claim, a t-test was carried out as shown;

Table 4.4: t-test for equality of means between Male and Female (Post-test) Control Group

	t-test for Equality of Means						
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Post-test Scores	2.434	68	0.018	7.629	3.135	1.375	13.883

Table 4.4 contains the results of a t-test carried out to establish the difference in means for the post- test comparing scores between males and females. The p-value that was obtained was 0.018. Since the p-value was less than 0.05, there was sufficient evidence to say that the means were not equal. There was a difference in Biology achievement between boys and girls instructed through the conventional approaches of teaching process.

Table 4.5: Gender Means and Standard Deviations in the Post-test (Experimental Group)

Gender	N	Mean	Std. Deviation
Male	35	68.11	7.028
Female	35	65.60	8.555

Table 4.5 contains means and standard deviations for the post-test scores comparing performance between males and females in the experimental group. The number of females who sat for the post-test was equal that of males. The mean score for females was 68.11 while that for males was 65.60. A box plot was drawn to visualize whether the mean scores for control males and females were different.

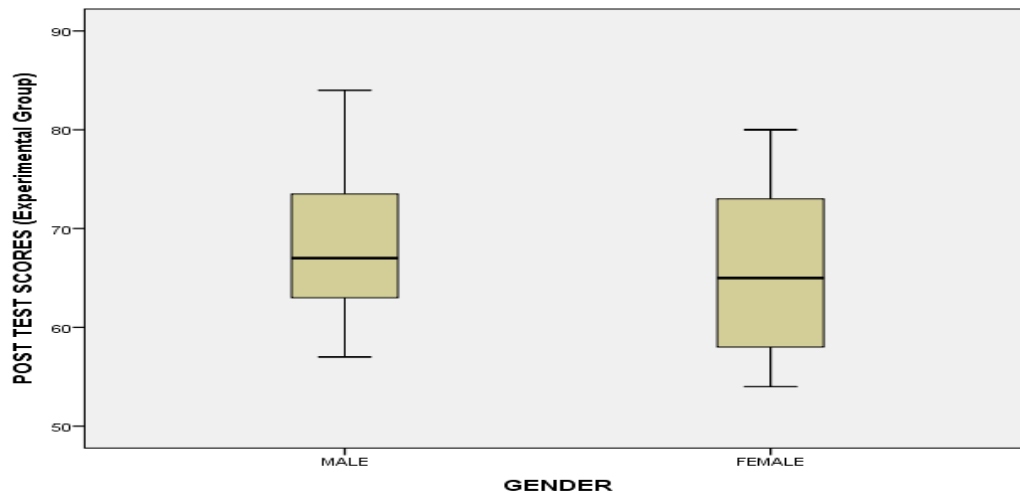
**Figure 4.3: Gender Post-test Scores (Experimental Group)**

Figure 4.3 contains boxplots that help in visualizing the distribution of scores for the experimental group during the pre-test comparing scores between females and males. From a glance, it could be seen that the experimental females' and experimental males' scores were equally distributed. To further investigate this claim, a t-test was carried out to establish whether the mean scores for males/females were different.

Table 4.6: t-test for equality of means between Male and Female (Post-test Experimental Group)

	t-test for Equality of Means						
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Post-test Scores	1.343	68	0.184	2.514	1.871	-1.220	6.429

Table 4.6 contains the results of a t-test carried out to establish the difference in means for the post- test comparing scores between experimental males and experimental females. The

p-value that was obtained was 0.184. Since the p-value was greater than 0.05, there was lack of sufficient evidence to reject the null hypothesis. There was no difference in Biology achievement between boys and girls instructed through computer assisted learning. Therefore, the mean scores for females and males were not different. This meant that the females and males were of equal ability at the post-test after CAL approach of instruction.

Discussion

It was observed from the results above that the pre-test mean scores for the females were 45.41 while that of the males was 55.39. The study concluded that the means were different. However, after the treatment with CAL, it was observed that the post-test mean scores for the females were 65.60 while that for the males was 68.11. The study concluded that the mean scores for females and males were not different. Hence the females and males were of equal ability after exposure to the computer-assisted learning. The results of this study are in agreement with what other researchers in the area of computer-assisted learning found out. Mubicakani & Koros (2014) found out that there was no significant difference between boys and girls in Mathematics achievement when exposed to CBL. In addition, Anyamene *et al.* (2012) found no significant difference on the performance of male and female taught using CAI package.

Conclusion

The study concluded that CAL as an approach of teaching and learning is more effective in bridging gender differences in terms of achievement. CAL as a method rises above gender insensitive approaches of teaching and learning such as lecture, discussion and question and answer methods which do not utilize computers.

Recommendations

CAL should be used to bridge the gender differences existing among male and female student in Biology. In addition, teacher training colleges and universities should train and equip fresh new teachers with the necessary skills and knowledge to properly integrate computers in their daily classroom processes. School electrification programme be continued to reach all secondary schools in the country especially those seated deep in the rural remote areas, this will ensure there is necessary infrastructure to power the computers and to run the e-learning programs in schools.

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