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Impact of Computer Aid Instructions on Locus of Control And Students' Performance In Mensuration Of SSS One Students In Kagarko Local Government Area of Kaduna State, Nigeria

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ABSTRACT

The study investigated the affects of Computer Aided Instruction (CAI) on students' performance and locus of control in learning geometry of SSS one students. The objectives of the study were: To investigate the effect of CAI on students' performance in geometry when compared with conventional method (CM), to establish gender difference in performance using CAI, to assess students' locus of control in the learning when taught using CAI and CM. The study adopted quasi experimental design. The study has population of 4982 students, consisting of 2678 males and 2304 females. The sample of the study consisted of 67 male and 62 female. There are 65 students in the experimental and 64 students in the control groups respectively. Four instruments were used for data collection; Student's Locus of Control, pre-test, post-test, lesson plan based on computer aid instruction and lesson plan based on conventional method. Student's Locus of Control questionnaire. The participants were taught volumes of cylinder and cone for six weeks. The Cronbach's Alpha of the tests was estimated to be 0.720 and 0.801 respectively. The differences between the groups means was analyzed using t-test and Mann-Whitney U-test, at $\alpha = 0.05$. The study revealed that, the students taught geometry with CAI obtained higher geometry scores and higher locus of control scores than the students taught with CM. The study further revealed that there were no gender differences in CAI group. It was recommended that mathematics teachers should use CAI and train students to develop internal locus of control.
Keywords : CAI, Geometry, Locus of control, Technology, Global Positioning System

I. INTRODUCTION

Science, technology, engineering, and mathematics (STEM) is acknowledged to be central to any Nation development. So also, STEM education has been seen as essential in promoting innovation, productivity and overall economic growth [1]. Similarly, mathematics is viewed as tool for achieving success in scientific and

technological development of any nation. Kareem [2] indicated that 80% of universities in Nigeria had a Mathematics department in the form of pure mathematics, applied mathematics, mathematics/computer science, mathematics/statistics, or mathematics/physics. A survey report also shows that all 100level students in every university that offer science, engineering and technology courses, take mathematics as a general course. Mathematics is considered as the gate and key of science and technology that is fundamental in social and economic development of any nation; therefore, for any nation to become competitive it must not undermine the significance of mathematics in her education [3]

Despite the importance of mathematics in science and technological advancement and its versed application in almost all sectors of development, its study in Nigeria secondary school level is bedeviled by incessant poor performance among the students [4]. The West African Examinations Council [5] Chief Examiner reports highlighted areas of students' weaknesses to include; poor knowledge on the rubrics of construction, and confusion on plane and solid shapes among others. Other research findings have confirmed that geometry is one of the topics among the abstract and complex aspects of mathematics that students find difficult to learn [6 &7].

The word "Geometry" is derived from the Greek word "Geo" and "Metron" which mean Earth and Measurement respectively or earth's measurement. Practically, geometry plays a great role in determining the areas, volumes, and lengths. One global application of geometry is in the Global Positioning System (GPS). Global Positioning System (GPS) is a space based satellite navigation system that provides location and time information in all weather conditions anywhere on or near the earth [8]. The GPS of the satellites use geometrical principles to calculate the position of the satellites. The use of coordinate geometry in the Global Positioning System (GPS) provides precise information about the location and time. GPS employed coordinates to calculate the distance between any two places. The coordinate geometry helps GPS to track transportation accidents and carry out rescue operations. The coordinate geometry also aids in enhancing flight security, weather forecasting, earthquake monitoring, and environmental protection. GPS is very important to determine the location of terrorist attacks.

The National Council of Teachers of Mathematics [9] stated that technology is an essential tool for learning mathematics in the 21st century, and all schools must ensure that their students have access to technological innovations such as instructional televisions, computers and other multimedia technologies. It should be noted that efficient teaching maximizes the potential of multimedia technology to develop students' understanding, stimulate their interest, and increase their proficiency in mathematics. Computer-Assisted Instruction (C A.I) is one of the multimedia instructions that has been empirically proved to enhance students' performance, arouse their interest, and reduce the boring and abstract nature of mathematics [10]. Computer-Assisted Instruction (CAI) is defined as the use of computers or other technology that serve as a learning medium or a medium for managing the learning process [11].In Computer Assisted Instruction, information is presented on computer display, students are asked to respond, and their response is evaluated. If response is correct, student moves ahead, if incorrect, similar problems are presented in another format till correct response is elicited.

According to [4] computers as an instructional media can come in different forms, computer based instruction (CBI), computer based learning (CBL), computer enhanced learning (CEL), computer aided learning (CAL), computer aided instruction (CAI) and computer assisted instruction (CAI). Computer Assisted Instruction (CAI) has been reported to be one

of the most effective instructional strategies for developing interest, more student-centered teaching, less lecturing, increased individual instruction, more time spent in coaching and advising students, increased interest in teaching and increased productivity, positive attitude, promoting retention ability of the students and improving the achievements of students, it is able to deal simultaneously with large number of students on individual basis [12].

One psychological construct that has various important educational implications and which is a variable in this study is locus of control. Locus of control strongly influences the decision to invest in learning. Locus of control is a psychological construct that refers to the degree to which individuals believe that they have control over the outcome of events in their lives. [13] referred to it as the extent to which individuals believe that they can control events that affect them. Locus of control stems from social learning theory and attribution theory, and refers to a person's perception about the underlying root causes of successes or failures in his or her life. [14] states that locus of control can be generalized into a basic dichotomy: internal and external. When individuals most often believe their successes and failures are due to factors within their control, they are viewed as having an internal locus of control. That is perceived that success or failure happened because of effort the individual put forward or did not put forward. On the other hand if individuals most often believe their successes and failures are due to something outside of their control. That is perceived that success or failure happened because of luck or task difficulty, they are regarded as having an external locus of control. Studies have established relationship between locus of control and academic attitude [15], mathematics achievement [16] and study habits [17].

The review of studies of [15, 17 &18] showed that students with internal locus of control demonstrate the following traits: obtain significantly high grade point averages (GPAs), show significantly low academic procrastination, low debilitating test anxiety, deeper and more elaborate study strategies, select tasks that are challenging, persistence and possess positive attitudes towards learning, and they are more proactive and effective during the learning process. On the other hand, students with external locus of control are characterized by procrastination, test anxiety, helplessness, depression, low academic achievement, superficial learning strategies, selection of less challenging tasks, and withdrawal of effort when difficulty is encountered and negative attitude towards academics.

Another important variable that is of interest to this study is gender difference in mathematics achievement. Investigation of gender differences in learning of mathematics is an issue that attracted the attention of mathematics educators. Some of the research on performance in mathematics has highlighted a traditional gender gap in favour of boys [19]. [20] used Programme for International Student Assessment (PISA) and data from an Italian national level learning assessment, involving children in selected grades from second to tenth. Their results showed that girls significantly underperform when compared with boys, even after controlling for an array of individual and family background characteristics, and that the average gap increases with children's age. Similarly, Programme for International Student Assessment [21] has found that girls outperform boys in reading and, to a lesser extent, that boys outperform girls in mathematics, on average across all participating countries. The Programme for International Student Assessment (PISA) is an every-three-year international survey of 15-year-old students aimed at determining their knowledge and skills in different domains. Students' abilities are assessed in the three curricular domains: mathematics, reading and science. In another development the Organisation for Economic Co-operation and Development (OECD) [22] used data from large-scale international assessments,

these include: Trends in International Mathematics and Science Study (TIMSS); Programme in Reading and Literacy Skills (PIRLS); Programme for International Student Assessment (PISA) and International Assessment of Adult Competencies (PIAAC) to follow representative samples of birth-cohorts over time, and analysed how gender gaps in numeracy and literacy evolve from age 10 to age 27. Their results suggest that, across the countries examined, males' advantage in numeracy is smallest at age 10 and largest at age 27. The growth in magnitude of the gender gap is particularly pronounced between the age of 15 and 27 that is, after males and females leave compulsory schooling and enter post-compulsory education.

However, the study of [23] showed that girls have obtained slightly better grades in mathematics over the last four decades than boys. This finding was also supported by the finding of [24] that girls and boys differ in mathematics achievement with girls outperforming boys at upper primary stage. [4, 25 & 26] in their studies revealed that male and female students taught geometry using CAI, geometry using mastery learning strategy and calculus using metacognitive strategy respectively did not significantly differ in achievement and retention scores.

Common explanations for gender disparities in mathematics achievement are girls display less mathematics self-efficacy (self-confidence in solving mathematics related problems) and mathematics self-concept (beliefs in their own abilities), and more anxiety and stress in doing mathematics related activities [27]. Similarly, compared to boys, girls had debilitating causal attribution pattern and were anxious about mathematics and they do not like competitive environment [18]. Some educational literature provide evidence that using variety of pedagogical strategies that address different learning styles within instructional environment can decrease gender inequality in achievements. Problem solving, class-discussions and investigative work and cognitive activation strategies have been found to improve girls' performances [27 &28].

With the use of Computer Assisted Instruction (CAI) the role of a teacher will shifts from being the key source of information and transmitter of knowledge to that of becoming a collaborator and co-learner. The role of the student also changes from passively receiving information to being actively involved in their own learning. This is in line with the constructivist theory of teaching and learning. Based on the above the current study wishes to investigated the impacts of computer assisted instruction (CAI) on locus of control and students' performance in mensuration of senior secondary school one students of Kagarko local government area, Kaduna State, Nigeria.

II. Purpose of the Study

Specifically, the purposes of this study are:

i. Find out if differences exist in mean performance scores of students taught mensuration using CAI method and those taught using conventional teaching method.
ii. If there will be shift in locus of control of students taught using CAI and those taught using conventional method.
iii. If there be any gender differences in mean performance scores of students taught using CAI

Research Questions

The following research questions guide the study

i. Will there be differences in mean performance scores of students taught using CAI method and those taught using conventional teaching method?
ii. Is there any change in locus of control of students taught using CAI and those taught

using conventional method?

iii. What are the mean performance scores of male and female students who were taught using CAI

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

H_{01}: There is no significant difference in mean performance score of students taught using CAI method and those taught using conventional teaching method.

H_{02}: There is no significant change in locus of control of students taught mensuration using CAI and those taught using conventional method.

H_{03}: There is no significant difference in mean performance score of male and female students taught using CAI method.

III. Materials and Methods

A quasi experimental design was adopted for the study. Specifically, non-randomized pre-test, post-test was used. This design is often used in classroom experiment where the learners are grouped together in the same learning environment. This design as suggested by [29] is appropriate when both the experimental and control groups are naturally assembled as intact classes. The independent variable (CAI) was manipulated and its effects on the dependent variables (locus of control and performance) are observed.

The population of the study consists of all S.S.1 students in public senior secondary schools in Kagarko Local Government Area of Kaduna State. There are sixteen public senior secondary school one with population of 4982 students, consisting of 2678 males and 2304 females. The Multistage sampling procedure was adopted. In the first stage, the cluster sampling was used to group the schools into two (8 each) according to environment and location. In the second stage two schools, one from each cluster were randomly chosen using a table of random numbers. In the third stage one school was randomly assigned as experimental and the other as control using flipping of coin. In the last stage one class each from the four arms of both experimental and control groups using simple random sampling. The sample of the study consisted of 129 students out of which 67 are male, while 62 are female. There are 65 students in the experimental and 64 students in the control groups respectively.

Four instruments were used for data collection; Student's Locus of Control, pre-test, post-test, lesson plan based on computer aid instruction and lesson plan based on conventional method. Student's Locus of Control questionnaire was adapted from Nicholson McBride Resilience Questionnaire (NMRQ). According to [30], (NMRQ) has validity (Cronbach's alpha=.800). Basic Mathematics Test (BMT) was used as pre-test. This consists of five theory questions drawn from New General Mathematics for West African textbook based on area, diameter and radius of circle, curved surface and total surface areas of both cylinder and cone. Volume of Cylinder and Cone Performance Test (VCCPT) was used as post-test. The test consists of five theory questions drawn from New General Mathematics for West African textbook based on volumes of both cylinder and cone. The test-retest method of reliability was used on the pre-test and post-test, Cronbach's Alpha of 0.720 and 0.801 were reported respectively.

Two lesson plans were developed on the volume of cylinder and cone and used to teach both experimental and control groups. Teaching using Computer Assisted Instruction (CAI) package and convention method were given to the experimental and control groups. The CAI package consisted of tutorials and drill and practice applications. The CAI package contained a set of quizzes, exercises and assignments at the end of each topic and sub-topics. The CAI package also consisted of an in-built evaluative system which provided immediate responses for answers supplied by the students as suggested by [31].

IV. RESULTS AND DISCUSSION

Results

Table 1: Results of the Mean and Standard Deviation of pre-test for Experimental and Control Groups

Groups	N	Mean	Standard Deviation	Mean Diff
Experimental	65	43.26	14.99	1.81
Control	64	41.45	10.36	

The data presented in Table 1 shows that the mean and standard deviation of the experimental group was 43.26 and 14.99 and that of the control group was 41.45 and 10.36. The mean difference is 1.81. In order to establish if the difference is statistically significant, inferential statistics was used to test the null hypothesis.

Table 2: t-test Comparison of Pre-test Scores of Experimental and Control Groups

Groups	N	Mean	Standard Deviation	Df	t-cal	t-crit	p-value
Experimental	65	43.26	14.99	127	0.80	1.98	0.05
Control	64	41.45	10.36				

Table 2 shows the t-test comparison of the mean score of control and experimental groups at pre-test. The result shows no statistical difference between the mean scores of the groups at 0.05 level of significance. (t_{cal}=0.80<t_{crit}=1.98, df= 127). Hence the two groups are equivalent.

Research Question 1:

Will there be differences in mean performance scores of students taught using CAI method and those taught using conventional teaching method?

Table 3: Mean and Standard Deviation of Post-test for Experimental and Control Groups

Groups	N	Mean	Standard Deviation	Mean Diff
Experimental	65	58.21	9.22	8.52
Control	64	49.69	14.62	

Table 3 shows that the mean and standard deviation of the experimental group was 58.21 and 9.22 and that of the control group was 49.69 and 14.62. The mean difference is 8.52.

Hypothesis Ho_1

There is no significant difference in mean performance score of students taught using CAI method and those taught using conventional teaching method.

Table 4: t-test of post-test for Experimental and Control Groups

Group	N	Mean	SD	DF	t-Cal	t-Crit	Remark
Post- test experimental	65	58.21	9.22	127	2.80	1.98	Sig.
Post- test Control	64	49.69	14.62				

Results of the independent t-test statistics on the performance of students who are exposed to CAI and those taught using conventional method revealed significant difference between the two groups. (t_{cal}=2.80>t_{crit}=1.98, df= 127).

This implied that the null hypothesis: there is no significant difference in mean performance score of students taught using CAI method and those who use conventional teaching method was rejected. This implies that the experimental group performed better than the control group.

Research Question 2:

Is there any change in locus of control of students taught using CAI and those taught using conventional method?

Table 5: Mean Rank and Sum of mean of Ranks of Post-test on Locus of Control of Experimental and Control Groups

Group	N	Mean Rank	Sum of Rank
E	65	83.75	5443.5
C	64	45.96	2941.5

Table 5 revealed that the mean and sum of ranks of locus of control of the experimental group was 83.75 and 5443.5, while that of the control group was 45.96 and 2941.5. The result thus showed that CAI method is more effective in enhancing students' locus of control towards the volume of cylinder and cone.

Hypothesis Ho_2

H_{02}: There is no significant change in locus of control of students taught mensuration using CAI and those taught using conventional method.

In order to establish if the difference in the ranks is significant, inferential statistic of Mann-Whitney U-test was conducted.

Table 6: Mann-Whitney U-test on Locus of Control for Experimental and Control Groups

Group	N	Mean Rank	Sum of Rank	U	U-cal	U-crit	Z	P	Remark

					861.5			
						112		
Experimental	65	83.75	5443.5	861.5				
						5.73746.	.00001	
							Sig.	
Control	64	45.96	2941.5	3298.5				

Table 6 showed that the result of the Mann-Whitney U-test of locus of control scores of student in experimental and control groups. Since the U-cal =861.5 is greater than U-critical=112 the null hypothesis that there is no significant change in locus of control of students taught mensuration using CAI and those taught using conventional method is rejected.

Research Question 3

What are the mean performance scores of male and female students who were taught using CAI

Table 7: Mean and Standard Deviation of Post-test for Male and Female of Experimental Group

Groups	N	Mean	Standard Deviation	Mean Diff
Male	33	51.22	16.12	
				0.82
Female	32	50.40	14.03	

Table 7 shows that the mean and standard deviation of the males was 51.22 and 16.12 and that of the female was 50.40 and 14.03. The mean difference is 0.82.

Hypothesis Ho_3

H_{03}: There is no significant difference in mean performance score of male and female students taught using CAI method.

Table 8: t-test for Male and Female in Experimental Group

	Gender	N	Mean	SD	DF	t-cal	t-crit	p-val	Remark
	Male								
Experimental		33							
			51.22	16.12					
					63	0.22	1.96	0.85	No Sig
	Female								
		32							
			50.40	14.03					

The above table 8 shows the results of the independent t-test statistics on the performance of male and female students taught using Computer Assisted Instruction (CAI). From the table, the p-value was 0.84 which is greater than 0.05, the t-calculated is0.21 which is less than the t-critical 1.96. The null hypothesis was thus upheld. This implies that there is no significant difference in mean performance score of male and female students taught using CAI strategy.

Discussions

The discussions of the findings of the present study is here been presented in relation to both research questions and hypotheses. The result from statistical analysis relating to hypothesis one as shown in Table 4 revealed that the experimental group that was exposed to Computer Assisted Instruction (CAI) perform better than the control group that was exposed to conventional method. The finding of this study agreed with the study of [4 & 31] whose studies revealed that CAI improved the spatial skills of student and students who were taught chemistry with CAI obtained higher chemistry achievement scores respectively. Table 6 results revealed that there was significant difference in the locus of control scores of student in experimental and control groups. The students taught mensuration using CAI showed more of internal locus of control when compared to those taught using conventional method. This finding is in consonance with the findings [12 & 31] that showed that CAI enhance academic attitude and self-efficacy both of which are related to locus of control. Table 8 showed that there is no significant difference in mean performance score of male and female students taught using CAI strategy. This finding is analogous with findings of [4 & 25] who found no gender difference when students are taught using CAI and mastery learning strategies respectively. However, the finding was heterologous with the finding of [6] who found that female students scored better compared to male students when taught using geo-gebra which is also an interactive tool.

V. CONCLUSION

The conclusions of this study are made based on the investigated problems. The results of data analysis clearly indicated that students in experimental group achieved higher in the geometry than students in the control group. Again the experimental group taught with CAI showed more of internal locus of control compared with those in the control group taught with conventional method. Girls and boys in the experimental group taught using CAI were found to have performed equally. Therefore the computer aided instruction is effective in teaching and learning mathematics, particularly geometry aspects and it is gender friendly.

Recommendations

According to the backgrounds and the findings of the current study and analysis of related studies of which most of them verify the role of CAI in the academic progress and enhancing academic locus of control. The following recommendations are made:

i. Computer assisted instruction was found to be effective as a teaching strategy when compared with conventional method of instruction. Therefore, mathematics teachers should be encouraged to use it.
ii. Male and female students were affected positively by the use of computer assisted instruction. Therefore, mathematics teachers should employ this strategy to close the gender difference in mathematics performance.
iii. Students should be trained to develop more of internal locus of control to enhance their self-

efficiency and self- dependence which can make them learn the concepts that are difficult in Mathematics.

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