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EFFECTS OF COMPUTER ASSISTED INSTRUCTIONS VIA ARTIFICIAL INTELLIGENT (AI) TECHNIQUES ON STUDENTS' ACADEMIC PERFORMANCE IN GEOMETRIC CONSTRUCTIONS IN SOKOTO STATE, NIGERIA

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ABSTRACT

This study investigated the Effects of Computer Assisted Instructions on Students' Academic Performance in Geometric Constructions among Senior Secondary Schools in Sokoto States. Twelve (12) with a total of 292 SS 2 students were sampled for the study using stratified sampling technique. Three research questions and three null hypotheses were raised to guide the conduct of the study. One instrument SGCT with reliability index 0.86, was adapted and used for data collection. T-test and ANOVA statistical analysis at $\alpha = 0.05$ level of significance were used to test the hypotheses. Two null hypotheses were rejected and the last hypothesis was retained. Base on the findings, it was recommended that since the results of teaching through the use of Computer Assisted Instructional Method was proved to be better than traditional method, it is therefore recommended that Ministry of Educations (MOEs), Curriculum planners and Developers should review their policies to inculcate this strategy in teaching science and science related subjects designed in the Nigeria Curriculum System of Education. Parents were also recommended to use the benefits of the findings of this study to support both their children and the school with these computer electronic gadgets for better performance of students in science subjects.

Keywords: Computer Artificial Intelligent (AI) Instructions, Geometric Constructions.

Introduction

In today's information age, the growth of the technology and computer-oriented education system guide educators to explore new teaching methods that can be used at any level of classroom environment as an alternative to teacher directed techniques (Muhanna, 2015). Computer and the internet make possible new methods of delivering instruction so that students will have choices of when, where and how they learn mathematics.

Computer Assisted Instruction (CAI) refers to the use of computers to present drill and practice, tutorials or simulative activities offered either by themselves or as supplement to traditional teacher directed instruction (Likit & Mamuda, 2022). In the same vein, Artificial Intelligence (AI) refers to the development of computer systems that can perform tasks typically requiring human intelligence such as learning, problem-solving, decision-making, perception and understanding lanquage. In teaching mathematics, AI's importance includes:

1- Personalized Learning: AI adapts to individual students' pace, offering tailored exercises and feedback.
2- Intelligent Tutoring: AI systems provide one-on-one support, identifying strengths/weaknesses.
3- Automated Grading: AI speeds up grading, freeing teachers for more interactive work.
4- Interactive Tools: AI-powered tools make math more engaging (e.g., simulations, games).
5- Predictive Insights: AI identifies students needing extra help, improving outcomes.

The use of computer assisted instructional packages as a teaching and learning tools, also suggest opportunities for learner's control, improved enthusiasm, associations to the real world and enhance students' achievement as a measure in variety of ways, including, standardized achievement test (Anigbo & Ndukwe, 2016). In this study therefore, Computer Assisted Instruction (CAI) via Artificial Intelligent (AI) refers to the use of Computer Artificial Intelligent Techniques (CAIT) of manipulating animated pictures of geometrical instruments through simulations to facilitate teaching and learning of geometrical constructions using educational mathematics software through direct interaction between students and computer individually.

The traditional instruction approach on the other hand refers to the use of conventional standard methods and tools in teaching, such as the use of rulers, pencil and paper to carry out the content of the given subject (Agwagah, 2016). Learning takes place in this standard method in the classroom as well, work is presented on the board and the use of textbook is commonly practiced. The instruction is teachers' oriented, question-answer method is mostly used. The traditional method of teaching mathematics has always dominated teaching and learning of developmental mathematics in secondary schools. In this light, this study will investigate whether there are differences in the academic performance of students in geometric constructions using computer-assisted instruction and traditional instruction

Geometric construction is part of pure geometry known as synthetic geometry or axiomatic geometry. This is the geometry that does not rely on equations and coordinate systems. Geometric construction is the process of creating geometric objects using only a compass and a straightedge. It is a component of pure geometry, which, unlike coordinate geometry, does not use numbers, formulae, or a coordinate system to create and compare geometric objects (Kathleen & Likita, 2022). Instruments that were mostly used in construction of geometrical figures and shapes are pair of compasses and a ruler.

Statement of the Problem

Sokoto state has many technical colleges and senior secondary schools teaching mathematics and technical subjects designed in Nigerian curriculum. Teachers handling these schools were all certifiably technically and mathematically qualified. Technical and instructional materials

and equipment were all available in these schools. However, despite all the certifiable teachers and the materials available, the performance of students in geometric constructions, technical and engineering drawing, was poor (Suleiman & Nasiru, 2019, Rotimi, Victor & Kabiru, 2011). According to their reports, the poor students' performance in those areas was because most teachers skipped this segment because of its difficulty and commitment required from both the teachers and students. The few teachers that teach the topics adapted traditional method of teaching where students were given some photocopies of constructed geometric figures from the texts to study and memorize during examinations.

In this study therefore, the researchers used Computer Assisted Instructions (CAI) via Artificial Intelligent (AI) techniques in teaching to ascertain the level of students' performance in geometrical constructions in Sokoto State.

Objectives of the Study

The objectives of this study are:

1- To determine the effects of computer assisted instruction on students' academic performance on geometric constructions among senior secondary school students in the five educational zones in Sokoto State.
2- To find out if gender difference exists in academic performance between senior secondary school students taught geometric constructions using Computer Assisted Instructional method in Sokoto State.
3- To find out if differences exist in academic performance between senior secondary school students taught geometric constructions using Computer Assisted Instructional method among the three educational zones in Sokoto State.

Research Questions

The following research questions were raised to guide the study:

1- Is there any difference in academic performance between students taught geometric constructions using Computer Assisted Instructions and those taught using conventional method in Sokoto State?
2- Is there any gender difference in academic performance between male and female senior secondary school students taught geometric constructions using Computer Assisted Instructional method in Sokoto State?
3- Is there any difference in academic performance between senior secondary school students taught geometric constructions using Computer Assisted Instructional method among the three educational zones in Sokoto State?

Null Hypotheses

The following null hypotheses were also generated to guide the conduct of the study:

1- $\boldsymbol{H_{01}}$: There is no significant difference in academic performance between students taught geometric constructions using Computer Assisted Instructions and those taught using conventional method in Sokoto State.
2- $\boldsymbol{H_{02}}$: There is no significant gender difference in academic performance between male and female students taught geometric constructions using Computer Assisted Instructions in Sokoto State.

3- $\boldsymbol{H_{03}}$: There is no significant difference in academic performance between senior secondary school students taught geometric constructions using Computer Assisted Instructional method among the three sampled educational zones in Sokoto State

Review of Related Empirical Studies

Many literatures conducted related to the use of electronic gadgets such as computers packages to assess the students' performance in teaching and learning was reviewed in and outside Nigeria. Some of them include the study conducted by Ukaigwe & Evelyn (2022). They conducted a study to assess the Effects of CAI on Mathematics performance among Secondary School Students in Rivers State. The sample used was 35 students out of 215 students in a senior secondary school Kpor in Gokana Local Government Area of River state. The instrument used to collect data was multiple choice achievement tests with the reliability index of 0.81. Z-test was used to test the hypotheses at 0.05 significant levels. The findings of the study showed that students taught with computer assisted instruction performed higher than those taught with traditional instructional methods. Findings also revealed that female students performed significantly better than male students in their post-test.

Lawal (2020) conducted a research to assess the Effect of Computer-Aided Instruction on the Performance of Senior Secondary School Students in Geometry in Katsina, Katsina State, Nigeria. The study examined the significance of retention achievement scores of students taught using computer-aided instruction and those taught using the traditional method. Three research questions and three hypotheses were formulated, and tested at 0.05 level significance using t-test. The results indicated that students taught using (CAI) performed significantly better than their counterparts taught using the traditional method of instruction. It was also found that there was no significant difference in performance scores of male and female students.

Muhanna (2015) conducted a study to assess the Impact of Using a Computer Assisted Instructional Package (CAIP) on the Acquisition of Mathematical Concepts and Developing the Skills of Scientific Thinking among the Tenth Grade Students at Irbid 1st Directorate of Education in the city of Irbid in Jordan. Sample of 114 students were selected from the tenth grade students of Ruqaya bint Al-rasoul school. The study showed significant differences between the mean scores of the experimental group members and the mean scores of the control group members where experimental students were found to performed better in both acquisition of mathematical concepts and developing the skills of scientific thinking.

Ndanwu and Ezejiofor (2021) conducted a study on Maximizing the benefits of computer assisted instruction for effective learning of electronic libraries course among third year students in federal tertiary institutions in Anambra State. The sample of the study comprised 60 respondents made up of male and female students in Federal College of Education (Technical), Umunze and Nnamdi Azikiwe University, Awka. Three research questions guided the study while one hypothesis was tested. The study revealed benefits of CAI to third year Electronic Libraries course students. The finding also showed no significant difference between the mean ratings of male and female Electronic Libraries course students on strategies for maximizing the benefits of computer aided instruction to Electronic Libraries course students.

Likita and Mamuda (2022) investigated the effects of Computer Assisted Instruction Program on Performance and Retention of Senior Secondary School Students in Mathematics (logic and algebraic process) in Maiduguri Metropolitan zone of Borno State, Nigeria. The sample consisted of three senior secondary schools purposively and proportionately selected consisting of (318) students with a combination of boys and girls. Two research questions and two null hypotheses were formulated and tested at 0.05 level of significant. The results of the students were analyzed using t-test statistical analysis. The result showed that the students taught logic and algebraic process using computer assisted instruction program performed significantly better than those taught using conventional method of instruction. Also the results indicated there was no significance difference on the performance of male and female students taught logic and algebraic process using (CAI) Computer assisted instruction program.

In another research, Ullaskar (2019) conducted a study to determine the Effectiveness of teaching mathematics through computer assisted instruction and traditional method at higher secondary level in Murshidabad District of West Bengali Area in Kenya. The total number of sample was 300 students selected from class 11th standard only who studies Mathematics in Science/Arts stream. The instrument used for data collection was Mathematics Achievement Test (MAT) with reliability index of 0.81. The findings revealed that significant differences have been found between the control and experimental group on post-test scores. The experimental group, which was taught by CAI, showed better retention learning. The result also showed no gender difference in mathematics achievements

However, in most of the related empirical studies reviewed within and outside Nigeria, it was found that research in geometric constructions which is very vital topic in the field of architectural designing, technical and engineering drawing was not conducted using any electronic means such as computer assisted instructional package in Sokoto state, despite the fact that it was proved to be a challenging task for the students. Also in the previous studies reviewed it was observed that, students were only exposed to calculation of sizes, angles, areas, and perimeters of drawn geometric figures on the chalkboard or text. In this study therefore the researchers used computer assisted instructional package to teach the sampled students how to construct some geometric figures using computer system and projectors, in the four sampled educational zones of Sokoto state.

Research Methodology

The target population of for study is the whole senior secondary school students in the five educational zones in Sokoto. It was found that there are two hundred and fifty (250) public senior secondary schools in five educational zones with a total of 2,302 SS II students in Sokoto State. 12 senior secondary schools that have functioning computer laboratories were sampled using purposeful sampling technique in the three educational zones with a total of 1,615 students. 6 male and 6 female senior secondary schools were sampled using stratified sampling technique. 292 students were selected to participate in the study.

Instrumentation

One instrument named Students' Geometric Construction Test (SGCT) was adapted by the researchers for the purpose of collecting data for this study. The instrument SGCT has two

sections. Section A contained twenty objective questions and section B contained 5 theory questions which students are to attempt any three.

Validity of Students' Geometric Construction Test (SGCT)

Students' Geometric Construction Test (SGCT) was submitted to experts for their assessments, comments and suggestions. On the basis of their comments, suggestions and advices some of the test items in the instrument were modified and some were reduced. Section A which has twenty objective questions was now reduce to ten objective questions. Section B which has 5 theory questions was also modified but number of questions was maintained. Marking schemes was also adjusted to 4 marks for each question answered correctly in section A, and a total of 20 marks for each theory question answered correctly in section B. This give a total of 100 marks if the required questions were answered correctly.

Reliability of Students' Geometric Construction Test (SGCT)

To obtain the reliability of SGCT, test and re-test method was conducted. This was done by administering the instrument (SGCT) to a sample of twenty (20) students from SSCOE Staff secondary school, Sokoto. After an interval of two weeks the same instrument SGCT was again re-administered to the same sample of twenty (20) students. Marks scored by each student from the two tests were recorded. Pearson's Product Moment Correlation was used to calculate the reliability index of SGCT using SPSS and it was found to be 0.861

Administration of the instruments

A pre-test was administered to all the sampled students using SGCT. Scripts were marked and students' scores were recorded. The Experimental Groups were taught geometric construction using CAI for six weeks and with 80 minutes per a double period as allocated in the school time-table. The controls Group (CG) were also taught using normal traditional methods of using chalkboard mathematical sets for the same equal period of time. Post-test was then administered using the same SGCT instrument to both the groups (EG) and (CG)

Data Presentation and Analysis

Students' scripts were marked and their performances were scored and recorded as 100% maximum mark. T-test statistical analysis was used to analyze students' performance at α = 0.05 level of significance. Also, One Way Analysis of Variance (ANOVA), and Schefis test were also used to analyze and investigate to find out whether significant difference exist and where it existed in the students' performance among the sampled educational zones in Sokoto states.

Null Hypothesis One (H_{01})

There is no significant difference in academic performance between students taught geometric constructions using CAI and those taught using conventional method in Sokoto state. To test this hypothesis, t-test was used and the result was presented in table 1 below

Table 1: Summary of T-test analysis of null hypothesis one (H_{01})

Groups	No. of Students	Mean ($\bar{x}$)	SD (σ)	SD Error ($\bar{x}$)	Mean Difference	df	t_{cal}	P	Decision
EG	134	52.82	12.15	1.05	16.62	290	11.94	0.000	H_{01} Rejected
CG	158	36.20	11.58	0.92					

Source: *Field work, 2025* $\alpha = 0.05$

Table 1 showed the summary of the t-test analysis for the difference in performance between students taught geometric constructions using CAI and those taught using traditional method in Sokoto States. The results showed that the $P = 0.000$ is less than the $\alpha = 0.05$. From the rule, when the P-value is less than the alpha value, the null hypothesis is rejected. This implies that null-hypothesis one which says there is no significant difference in academic performance between students taught geometric constructions using CAI and those taught using traditional method in Sokoto state was therefore rejected.

Null Hypothesis One (H_{02})

There is no significant gender difference in academic performance between male and female students taught geometric constructions using CAI in Sokoto state. T-test was used to test the hypothesis and the result was presented in the table 2 below

Table 2: Summary of the t-test analysis of Male and Female students performance

Gender	No. of Students	Mean ($\bar{x}$)	SD (σ)	SD Error ($\bar{x}$)	Mean Difference	df	t_{cal}	P	Decision
Males	59	50.20	10.64	1.39	4.68	132	2.25	0.026	H_{02} *Rejected*
Females	75	54.89	12.88	1.48					

Source: *Field work, 2025*

Table 2 shows the summary of the t-test analysis of female students' performance in Sokoto States. The results showed that the $P = 0.026$ is less than the $\alpha = 0.05$. From the rule, when the P-value is less than the alpha value, the null hypothesis is rejected. This implies that hypothesis two was also rejected. This reveals that, female students performed significantly better than male students in geometric constructions with the use of CAI in Sokoto state.

Null Hypothesis Three (H_{03})

There is no significant difference in academic performance between senior secondary school students taught geometric constructions using Computer Assisted Instructional method among the three educational zones in Sokoto State. The result is presented in the table 3

Table 3: Summary of One Way ANOVA Analysis of Null Hypothesis Three (H_{03})

Source	Sum of Squares	df	Mean Square	F_{cal}	P	Decision
Between Groups	87.828	2	43.914	0.294	0.746	H_{03} Retained
Within Groups	19561.224	131	149.322			
Total	**19649.052**	**133**				

Source: *Field work, 2025* $\alpha = 0.05$

Table 3 is the summary of ANOVA for the difference between the academic performances of among the three sampled educational zones in Sokoto state. The results of the analysis showed that $P = 0.746$ is greater than $\alpha = 0.05$. From the rule, when the P – value is greater than the alpha value, the null hypothesis is accepted. This implies that the null-hypothesis three was retained. This implies that, students taught geometric constructions using CAI in the three sampled educational zones in Sokoto state performed equally the same.

Summary of the Major Findings

The summary of the major findings shows that:

1- Students taught geometric constructions using CAI method performed significantly better than those students taught using traditional method in Sokoto states.

2- Female students taught geometric constructions using computer assisted instructions performed significantly better than male students in Sokoto states.

3- There was no significant difference in academic performance between students taught geometric constructions using Computer Assisted Instructions among the three sampled educational zones in Sokoto State.

Discussion

The first finding reveals that, there was significant difference between the academic performance of students taught geometric constructions using computer assisted instructions and those taught using traditional method in Sokoto states. This finding was in line with the findings of Ukaigwe and Evelyn (2022), Lawal (2020), Muhanna (2015), Ndanwu and Ezejiofor (2021), Likita & Mamuda (2022) Ullaskar (2019). However, the finding was in total disagreed with the finding of Leann (2020)

The second finding of this study reveals that, there was significant difference between the academic performance of male and female students taught geometric constructions using computer assisted instructions where female students performed significantly better than male students in Sokoto states. This finding agreed with the findings of Ukaigwe and Evelyn (2022), Kofi, Nelly and Valentina (2019). However, the finding disagreed with finding of Harbor-Peter (2002), Ndanwu and Ezejiofor (2021). Likita and Mamuda (2022), and Ullaskar (2019)

The third finding shows that there was no significant difference in academic performance between students taught geometric constructions using Computer Assisted Instructions

among the three sampled educational zones in Sokoto State. This implies that, students taught geometric constructions using computer assisted instructions in the three sampled educational zones in Sokoto state performed equally the same regardless geographical locations. This finding agreed with the finding of Leann (2020), Ukaigwe & Evelyn (2022), Lawal (2020) and Muhanna (2015), Ndanwu & Ezejiofor (2021), Likita & Mamuda (2022), Koni, Zephaniah, & Mercy (2019) and Alhassan, Ezenwa & Wushishi (2015). They carried out their studies to investigate the effect of computer assisted instructional package on secondary school student's performance in different states of Nigeria. The result from the study showed that there was no significant difference between the mean achievement scores of students when compared with the students' performance among their different states.

However, the finding was not in conformity with the finding of the study conducted in Ghana by Kofi, Nelly and Valentina (2019) in Greater Accra, Western, BrongAhafo and Ashanti Regions in Ghana. Their results showed that region has significant effects students' performance among their different geographical locations in integrated science under the use of computer-assisted instructional methods

The finding also disagree with the finding of Alhassan, Ezenwa & Wushishi (2015) and Ullaskar (2019) whom conducted their studies to determine the effects of teaching mathematics through computer assisted instruction and traditional method in Niger state and Murshidabad District of West Bengali Area in Kenya. Their findings revealed that significant differences in students' performance have been found among their different regions and locations.

Conclusion

Base on the findings of this study, the following conclusion was drawn:

1- The use of Computer Assisted Instructions in teaching geometric constructions resulted in higher performance of students over traditional methods in the three sampled educational zones in Sokoto state, Nigeria.
2- Female students had higher significance performance in geometric constructions than their male counterpart under the use of computer assisted instructions in Sokoto State.
3- Students' geographical locations or educational zones have no any effects on their academic performance in geometrical constructions under the use of computer assisted instructional method.

Recommendations

Based on the findings of this research, the following recommendations were made:

1- Since the use of CAI method in teaching geometric constructions was proved to be better than traditional teaching method, it was recommended that Government, Stakeholders of Science and Technology, should use the findings of this study to give more support towards teaching of mathematics, sciences, technology subjects through CAI method.
2- Since the results of using computer assisted instructional method shows that female students can performed even better than male students, it was recommended that stakeholders, educational agencies, and None Governmental Organizations (NGOs) should mobilized and adapt the idea of using computer software in teaching mathematics, sciences and technical subjects. This will encourage greater females'

participation in mathematics and would also discourage the idea of taking the subjects to be for masculine only.

3- Parents should use the benefits of this finding to encourage their children with those electronic gadgets that support and make learning permanents for a better change of Nigerian society.

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