EFFECTS OF VIDEO-AIDED INSTRUCTION ON STUDENTS' LEARNING ACHIEVEMENT IN GEOMETRY IN COLLEGES OF EDUCATION, GHANA

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Abstract

The study investigated how students' learning achievement in geometry at a college of education in Ghana was affected by video-aided instruction. The study used a pre-test-post-test non-equivalent control group quasi-experimental research design. Two research questions and two null hypotheses served as the study's pointer. The study included a sample size of 58 undergraduate mathematics students. The sample consisted of 21 students in the control group and 37 students in the experimental group. The Geometry Achievement Test (GAT) was used to compile the data. Experts in mathematics education and instructional technology determined the validity of the instrument. A reliability coefficient of the GAT was calculated using Kuder-Richardson's formula 21 and was found to be 0.87. Analysis of Covariance (ANCOVA) was utilized to test the hypotheses at the 0.05 level of significance while mean and standard deviation were employed to examine the data obtained to provide answers to the research questions. Based on the study's findings, undergraduate students who were taught geometry with the help of videos did better than those who were taught geometry with diagrams. However, employing video-assisted instruction, there is no discernible difference in learning outcomes between male and female students pursuing geometry. The study's findings led the researchers to suggest that geometry instruction in Ghana's Colleges of Education be supported by video.

Keywords: *Geometry, Achievement, Video-assisted instruction, Students, Gender*

Introduction

The mathematical community who study geometry are encouraged to appreciate their surroundings. Geometry was referred to as "earth measure" by the ancient Greeks. The Greeks referred to geometry as "geometreo," where "geo" stands for "earth" and "metreo" for "measure." In the words of Gamboa and Ballestero (2009), geometry is viewed as a sphere of reflection that encourages a range of methods for approaching mathematical issues and comprehending the universe in both natural and artificial contexts. It also plays a significant role in daily life since it naturally occurs in the solar system's architecture, in rocks and crystals, as well as in plants, flowers, and animals (Lie & Hafizah, 2008). The nature of geometry also encourages students the abilities of visualization, critical thinking, anticipation, problem-solving, hypothesis creation, deductive reasoning, and logical argumentation in testing and demonstration procedures (Jones, 2002). As a theme within mathematics, geometry is crucial for enhancing students' spatial awareness, intuition, visualization, and problem-solving skills. National Council of Teachers of Mathematics (2000a) posited that a basic understanding of geometry is necessary for every student to succeed in school and in real-life situations. This is because geometry enables people to interpret and reflect on their surroundings.

Despite the significance of geometry in mathematics, both instructors and students find it challenging to teach and learn (National Council of Teachers of Mathematics, 2009). The results of the study of Baffoe and Mereku (2010) highlighted questions about the geometric thinking abilities of students in Ghanaian schools and

institutions. The student teachers' presentations of solutions to the majority of geometrical problems were subpar, according to the annual reports of the chief examiners for the end-of-second-semester mathematics examination in geometry at the College of Education level in 2011 and 2012 (University of Cape Coast, Institute of Education, 2011; 2012). Similar findings were found in the chief examiners' reports of 2013 and 2014, which were published by the University of Cape Coast's Institute of Education (2013; 2014). These reports showed that applicants lacked sufficient understanding of geometry and the application of geometric concepts. Poor academic achievement in geometry was caused by the fact that the majority of students did not acquire the necessary problem-solving abilities or level of comprehension of geometric concepts. Students' poor performance in geometry is related to teachers' inability to use suitable and effective teaching strategies that would interest students and assist them develop their geometric thinking (Alex & Mammen, 2012). Armah et al. (2017) posited that most Ghanaian student-teachers have poor geometrical comprehension, and students' poor academic achievement in geometry may be related to their belief that geometry is a challenging topic to master. Other issues with teaching and learning geometry have also been identified by research, such as the pedagogy of the teachers, students' lack of interest in geometry, their lack of comprehension of geometrical ideas, and their lack of use of technology (Dinayusadewi & Agutika, 2020; Ngirishi, 2015). The poor academic performance of students in geometry was also attributed to their lack of grasp of geometric ideas, inability to see the connections between geometric properties, forms, procedural and conceptual understanding (Ngirishi, 2015). The chief examiners' reports from May/June (2010, 2011) showed that students' performance in geometry has not been adequate, hence the idea that students' performance in geometry is poor is also used to characterize student performance. Researchers (Noraini, 2006; Aysen, 2012) have identified a number of factors that contribute to students having difficulty grasping geometry, including a lack of background knowledge, poor geometric reasoning abilities, a lack of comprehension of geometric language, a lack of visualizing skills, teachers' teaching methods, a lack of instructional materials, and others.

Research has shown that gender has an effect on students' ability to learn geometry. The research evidence of Uduosoro (2011) revealed that male students fared better than female students in geometry, while on the contrary Ominrin (2009) revealed that female students surpassed male students in geometry. There is no difference in geometry competency between male and female students, according to a comparable research study (Gbodi & Olaleye, 2006; Adegun & Adegun, 2013). According to Royati et al. (2010), learning geometry is a difficult cognitive exercise for students, and the chief examiners' report of the West African Examination Council (WAEC) in 2014 and 2015 noted that students' performance in geometry was subpar, with the majority of students attempting related questions ineffectively. Correspondingly, the concept of students' learning achievement in geometry was rated as very low, as Telima (2012) hypothesized that students failed to grasp key concepts in geometry, and likewise indicated that the learning of geometry is assumed to be difficult due to geometric language, visualizing abilities, and the teacher's instructional strategy (Aysen, 2012; Noraini, 2006) .

Investigation results in the domain of mathematics education is irresolute, whilst most research result indicated that there is significant difference in learning achievement between students taught mathematics using the computer-based instruction and those taught with expository instructional approach, other results revealed that there is no significant difference in learning achievement between students taught mathematics using the computer-based instruction and those taught using expository instruction.

In Enugu State, Nigeria, Onah et al. (2020) explored how computer-assisted instruction affected student's proficiency in mathematics and physics. 200 students were chosen to take part in the study using a purposeful sample strategy. The Mathematics Achievement Test (MAT) and the Physics Achievement Test (PAT) were used in the study's quasi-experimental pre-test-posttest research strategy to gather data. Using the Kuder-Richardson formula 20, the reliability coefficients for MAT and PAT were calculated to be 0.86 and 0.75, respectively. Data collected was analyzed using mean. Standard deviations and analysis of covariance. The result of the study showed that students taught mathematics using computer-assisted instruction significantly outperformed their counterparts taught with the conventional teaching method.

Gongden and Gongden (2019) also looked at how fundamental science achievement among male and female students in Jos Metropolis, Nigeria, was impacted by computer-assisted instruction. With 153 JSS2 students as the sample size, the study used a quasi-experimental pre-test post-test research methodology. The Basic Kinetic Achievement Test was used to gather the data, and descriptive statistics and the t-test were used to evaluate it. The study's findings demonstrated a huge academic performance gap between students in the experimental group and those in the control group, with the experimental group outperforming the control group.

The impacts of computer-assisted instruction on mathematics achievement among secondary school pupils in Rivers State, Nigeria, was also studied. The study used a pre-test-post-test quasi-experimental approach that was informed by two research questions and hypotheses. Using simple selection at random procedure, a sample size

of 35 students was chosen and data were gathered using an achievement test. Experts validated the instrument, and the reliability coefficient was calculated using Kuder-Richardson formula 20 to arrive at a value of 0.81. Data collected was analyzed using mean, standard deviation and z-test. The result of the study showed that the students taught using computer-assisted instruction performed significantly better than their counterparts taught with the conventional teaching method (Ukaigwe & Goi-tanen, 2022).

In Ilorin, Kwara State, Nigeria, Enikanolaye (2021) also looked into the impact of a multimedia instructional strategy on the retention and performance of senior secondary school students in mathematics. With eighty one Senior Secondary Two (SS2) students as its sample size, the study used a quasi-experimental pre-test-posttest research design, and the Mathematics Performance Test (MPT) to gather data. The Pearson Product Moment Correlation method was used to calculate the reliability coefficient of 0.87. The mean, standard deviation, analysis of covariance, and t-test were used to analyze the data that was gathered. Pursuant to the study's findings, the experimental group performed significantly better academically than the control group compared to both groups overall.

Simkhada (2021) also investigated the effect of multimedia instruction in mathematics classes at Shree Baraha Kalika Secondary School. The research design for the study was a quasi-experimental pre-test and post-test approach. For the study, a purposive selection strategy was used to choose a sample size of forty grade IX students. Achievement testing and a questionnaire were used to gather data. The mean, standard deviation, and t-test were used to examine the data. The result of the study showed that the students in the experimental group perform significantly better than those in the control group.

In Onitsha North Local Government Area of Anambra State, Nigeria, Oraneto and Omile (2021) also investigated the impact of an ethnomathematics teaching style on students' achievement and interest in mathematics. Two research questions and hypotheses served as the study's guiding principles, and a quasi-experimental pre-test-post-test non-equivalent control group design was used. Purposive sampling was used to choose 100 SS1 students as the study's sample size. The Mathematics Achievement Test and the Mathematics Interest Inventory were used for collecting data. Using the Kuder-Richardson formula 20 and the Cronbach alpha, the reliability of the MAT and MII were found to be 0.82 and 0.72, respectively. The mean, standard deviation, and analysis of covariance were used to examine the data. The study's findings showed that students who were taught math using an ethnomathematics instructional strategy significantly outperformed those who were taught using a traditional method of instruction.

At Maximino Noel Memorial High School in Carcar City, Abuton (2022) also looked into how video-based instruction affected the teaching of mathematics to seventh-grade students. Data were gathered utilizing the Division Achievement Test from a sample of fifty students as part of the study's quasi-experimental pre-test-posttest research methodology. Mean, frequency count, and t-test were used to assess the data that had been gathered. The study's findings demonstrated that students who learned mathematics through video-based education did much better than their peers who learned the subject through chalk-talk instruction.

In Ilorin, Nigeria, Onasanya et al. (2022) investigated the impact of technology-enabled video instruction on senior secondary school student's performance in a few technical drawing subjects. Pre-experimental research using a one-group pre-test post-test design was used in the study, which included quantitative and qualitative methods. Students' Performance Test was used to gather data. The acquired data was examined using the t-test, mean, range, and standard deviation. As a consequence of the study, it was shown that students who were taught utilizing technology-enabled video instruction fared far better academically than those who were taught using the lecture technique.

In Makurdi Metropolis, Benue State, Nigeria, Nwaokolo et al. (2022) also investigated the impact of a video instructional package on the academic performance of secondary school students. Two research questions and hypotheses served as the study's guiding principles, and it used a quasi-experimental pre-test posttest research approach. The multi-stage sampling procedure was used to choose 138 SS2 students as the sample size. The Biology Achievement Test (BAT) was used to collect data, and specialists checked the validity of the results. Kuder-Richardson formula 20 was employed to assess the reliability of BAT. Data collected was analyzed using mean, standard deviations and analysis of covariance. The result of the study showed that there is significant difference in the academic performance between students taught Biology using video instructional package and those taught using lecture method in favour of the experimental group.

Akinoso (2018) also looked into how well students in Lagos State, Nigeria performed in mathematics after exposure to multimedia. A quasi-experimental pre-test post-test research strategy was used throughout the investigation, which was directed by three research questions and hypotheses. The Mathematics Achievement Test (MAT), which has a reliability value of 0.81 using KR-20, was used to gather the data. Utilizing the mean,

standard deviation, and analysis of covariance, the data was analyzed. The study's findings demonstrated that there is no discernible distinction in academic achievement between the experimental and control groups.

Similar research was conducted by Ikwuka and Adigwe (2021) in Edo State, Nigeria, on the impact of PowerPoint and video instructional packages on Christian Religious Studies (CRS) students' academic progress. With 126 SS2 students as its sample size, the study used a pre-test post-test non-equivalent control group design. The Christian Religious Studies Achievement Test (CRSAT) was used to gather the data. With a reliability value of 0.77, the validity and reliability of the CRSAT were assessed using experts and the KR-20, respectively. The mean, standard deviation, and analysis of covariance were used to examine the data. The study's findings demonstrated that CRS students who were taught using a PowerPoint teaching package performed noticeably better than those who were taught using a video instructional package.

Furthermore, research findings revealed that there is still debate regarding the effects of computer-based instruction on male and female students' learning achievement in mathematics. While some scholars' findings suggested that there is a significant difference between male and female students who receive computer-based instruction for mathematics, others revealed that there is no significant difference between male and female students who receive computer-based instruction for mathematics.

In Port Harcourt, Nigeria, Furo (2015) investigated how computer-assisted instruction and student interest affected SS2 chemistry students' success in chemical equilibrium. Pre-test post-test quasi-experimental control group design was used in the study. The achievement exam and the interest scale were used to gather the data, and the mean, standard deviation, and analysis of covariance were used in the analysis. The study's findings showed that there were no appreciable differences between male and female students who were taught chemistry utilizing computer-assisted education.

Similar research was conducted by Egbunu et al. (2017) in Makurdi Metropolis, Nigeria, on the impact of computer-aided instruction on pupils' retention in mathematics. The study used a quasi-experimental approach, and achievement tests were used to gather data. Utilizing the mean, standard deviation, and t-test to examine the data gathered. According to the study's findings, male students who were taught mathematics using computer-assisted instructions retained the material far better than female students.

Among junior secondary school students in Minna Metropolis, Nigeria, Safo et al. (2015) also looked at the effects of a computer-assisted instructional package on gender success and retention in geometry. The Geometry Achievement Test was used to collect data for the study, which used a pre-test-post-test quasi-experimental research method. Using Pearson's Product Moment Correlations, the reliability coefficient of 0.75 was calculated, and the t-test was used to analyze the data. The study's findings demonstrated that male students receiving computer-assisted instruction outperformed their female counterparts in terms of academic performance.

Furthermore, Gongden and Gongden (2019) looked at how fundamental science achievement varied between male and female students in Jos Metropolis, Nigeria. A sample size of 153 JSS2 students was used in the study, which used a quasi-experimental pre-test-posttest research approach. The Basic Kinetic Achievement Test was used to collect data, which was subsequently analyzed using descriptive statistics and the t-test. As indicated by the study's findings, there is no discernible difference in the academic achievement of male and female students who get computer-assisted instruction.

In addition, Enikanolaye (2021) looked on how senior secondary school students in Ilorin, Kwara State, Nigeria performed and retained information about mathematics. The study used the Mathematics Performance Test (MPT) to collect data, and it used a sample size of 81 SS2 students in a quasi-experimental pre-test posttest research method. Using Pearson Product Moment Correlation, the reliability coefficient of 0.87 was calculated, and the data gathered was examined using the mean, standard deviation, analysis of covariance, and t-test. According to the study's findings, there is no discernible difference between male and female students who are taught mathematics utilizing a multimedia instructional technique in terms of their academic achievement.

In Makurdi Metropolis, Benue State, Nigeria, Nwaokolo et al. (2022) investigated the impact of a video instructional package on secondary school student's achievement. Two research questions and hypotheses served as the study's guiding principles, which were implemented in a quasi-experimental pre-test post-test research methodology. 138 SS2 students made up the sample size that was chosen using a multi-stage sampling technique. The Biology Achievement Test (BAT) was used to collect data, and experts verified its validity. Kuder-Richardson formula 20 was used to assess the reliability of BAT. The mean, standard deviations, and analysis of covariance were used to analyze the data. The study's findings revealed no discernible differences in

academic achievement between male and female students who were taught biology utilizing a video instructional program.

The impact of video-type teaching materials on students' mathematics achievement of senior secondary schools in Minna, Nigeria, was also studied by Gambari et al. (2016). The study used a pre-test-post-test quasi-experimental research design. Five questions and hypotheses served as the study's guiding principles. Using basic random sampling techniques with a purposive, a sample size of 120 students was chosen. The Trigonometry Achievement Test (TRAT) was used to get the data. The KR-20 method was used to calculate the reliability of TRAT, which was found to be 0.87. Mean, standard deviation, analysis of covariance, and Sidak Post-hoc Test were used to analyze the data that had been gathered. The study's findings showed that male and female students who were taught mathematics via video-assisted instruction performed similarly academically.

Similar research was conducted by Olatayo et al. (2017) in Ilorin Metropolis, Nigeria, on the impact of video-mediated instruction on students' understanding of indices and logarithms. A quasi-experimental pre-test post-test research strategy was used throughout the investigation, which was directed by two research questions and hypotheses. Using basic random sampling methods with two intact classes, a sample size of 64 SS1 was chosen. The Mathematics Achievement Test was used to gather the data, which was then analyzed using the t-test, mean, and standard deviation. The study's findings showed that in the experimental group, female students fared noticeably better than their male counterparts.

In Lagos State, Nigeria, Akinoso (2018) also looked at the impact of multimedia on kids' arithmetic performance. Three research questions and hypotheses served as the study's guiding principles and a quasi-experimental pre-test post-test research approach was used. Data was gathered using the KR-20-reliable Mathematics Achievement Test (MAT), which has a reliability value of 0.81. The mean, standard deviation, and analysis of covariance were used to examine the data. The study's findings indicated that there was no discernible difference in the experimental group's academic performance between male and female students.

In a primary school in Lagos State, Nigeria, Obielodan et al. (2017) investigated the impact of video-based instruction on students' academic achievement. The research design for the study was pre-test-post-test quasi-experimental. The study included two complete classrooms with a sample size of 40 students chosen using a purposive selection technique. Utilizing the Mathematics Achievement Test (MAT), data was gathered. Utilizing the mean, standard deviations, and analysis of covariance, the data was examined. The study's findings showed that male and female students who were taught mathematics via video-based instruction did not differ significantly from one another.

In Abuja, Nigeria, Nonyelu and Anikweze (2019) looked at the impact of videotape instruction on gender differences in learning attainment. Using a simple random sampling procedure to choose the schools, the study used a pre-test and post-test quasi-experimental research design with a sample size of 322 JSS students. Two research hypotheses and two research questions served as the study's direction. Data was gathered using the MAT (Mathematics Achievement Test). Experts in mathematics, measurement, and evaluation as well as the Kuder-Richardson formula 21 provided the instrument scores of 0.85 and 0.62 for its validity and reliability, respectively. Utilizing the mean, standard deviation, and analysis of covariance, the data was examined. The result of the study showed that there is no significant difference in learning achievement between male and female students taught mathematics using video-based instruction.

In Minna Metropolis, Niger State, Nigeria, Yaki and Babagana (2016) investigated in equal measure the impact of a technology instructional package on secondary school students' biology performance. Two research hypotheses and questions served as the foundation for the investigation. A pre-test-post-test quasi-experimental research approach was used for the study. Using stratified and simple random sampling techniques 82 SS2 students were chosen as the sample size. Utilizing the Biology Achievement Test (BAT), data was gathered. Experts validated the BAT, and a reliability coefficient of 0.74 was obtained using the test-retest approach to evaluate reliability. Split-plot analysis of variance and the t-test were used to examine the data that was gathered. Male and female students who were taught utilizing a technological learning package did not demonstrate significantly different levels of learning accomplishment, according to the study's findings.

The review of the related empirical studies has shown an existing knowledge gap with regards to the use of the computer-based instruction in learning/teaching mathematics in Volta region Colleges of Education, Ghana. The observation from the results of the related empirical studies shows the need to bridge the research gap. Hence, the prompt to this investigation.

Statement of the Problem

Despite several interventions used to enhance learning outcomes by various scholars in mathematics education, students' academic performance in geometry leaves much to be desired. In the words of (Dinayusadewi & Agutika, 2020; West African Examination Council Chief Examiners' Report, 2010; 2017; 2018), among other issues, students' perception that geometry is difficult, teachers' use of passive instructional methods that do not support students' learning styles, and students lack of interest in geometry are all contributing factors to the inferior learning achievement. The digital era in which we are, has made the use of technological gadgets to permeate all walks of life. The present day students are all digital natives who appreciate the use of technology. Video-based instruction falls into the use of technology for instructional purposes. This study was therefore, embarked upon to ascertain the effect of video-assisted instruction on the academic achievement of students in geometry.

Aim and Objectives of the Study

The aim of the study was to investigate the effect of video-aided instruction on students' learning achievement in geometry. The study was specifically envisioned to;

1. examine the difference in the learning achievement between the students taught Geometry using the video-aided instruction (VAI) and those taught using diagram-aided instruction (DAI).

2. find out the difference in the learning achievement between the male and female students taught Geometry using the video-aided instruction.

Research Questions

The study was guided by the following research questions;

1. What is the difference in the learning achievement between the students taught Geometry using the video-aided instruction and those taught using diagram-aided instruction?

2. What is the difference in the learning achievement between the male and female students taught Geometry using video-aided instruction?

Hypotheses

The following null hypotheses were tested at a 0.05 level of significance;

H_{01}: There is no significant difference in the learning achievement between the students taught Geometry using the video-aided instruction and those taught using diagram-aided instruction.

H_{02}: There is no significant difference in the learning achievement between the male and female students taught Geometry using the video-aided instruction.

Materials and Method

The study used a quasi-experimental pre-test post-test non-equivalent control group research design with two intact classes. Using basic random sampling strategies with a purpose, 58 undergraduate mathematics students were chosen as the study's sample size. 24 male college students made up the experimental group, whereas 13 female undergraduate students made up the control group. Geometry Achievement Test (GAT) was the tool utilized to obtain the data. The GAT was composed of 20 multiple-choice questions with options A through D. The correct answer received five points, while the erroneous answer received a zero. A closed-ended question was also included to ascertain the gender of the students. The reliability coefficient of the GAT was assured using Kuder-Richardson's formula 21 as 0.87, and the validity of the instrument was assessed by specialists in mathematics education and educational technology. Table 1 shows the research design.

Table 1: Quasi-experimental design

Group	Pre-test	Treatment	Post-test
E	Q_1	X_{VAI}	Q_2
C	Q_1	X_{DAI}	Q_2

Where;
E = Experimental Group, X_{VAI} = Video-Aided Instruction
C = Control Group, X_{DAI} = Diagram-Aided Instruction
Q_1 = Pretest - GAT Q_2 = Posttest - GAT

The data collection procedure involved orientation of research assistants, pre-test, video-aided instruction, diagram-aided instruction, post-test as shown in Table 2

Table 2: Data collection procedure

S/N	Experimental Group	Control Group	Treatment
•	+	+	Pre-test (GAT)
•	+	-	Video-aided Instruction
•	-	+	Diagram-aided Instruction
•	+	+	Post-test (GAT)

Pre-test, video-assisted instruction, diagram-assisted instruction, and post-test were all steps in the data-gathering process. The research design, the video-assisted teaching, and the diagram-assisted instruction were all properly explained to the research assistants to ensure optimal and effective collection of data. Following the orientation, both the experimental and control groups were given the pre-test (GAT), which was then collected for scoring after 35 minutes. Following that, the experimental group received three weeks of video-assisted instruction in Geometry. Similar to the experimental group, the control group likewise learned the identical Geometry material over the period of three weeks, but with diagram-aided instruction. As a result, both the experimental and control groups underwent the post-test (GAT). After 35 minutes of working, the scripts were also collected for marking. The data obtained were analyzed using mean and standard deviations to resolve the research questions while the hypotheses were tested using Analysis of Covariance (ANCOVA) at the 0.05 level of significance.

Results

Table 3: Summary of descriptive statistics on the difference in the learning achievement between undergraduate students taught Geometry using VAI and those taught using the DAI

		Pre-GAT		Post-GAT		Gain-GAT	
Treatment	N	Mean	SD	Mean	SD	Mean	SD
VAI	37	36.76	7.47	68.92	9.29	32.16	9.17
DAI	35	34.86	7.22	53.71	5.60	18.86	5.30

The result from Table 3 shows the summary of descriptive statistics on the difference in the learning achievement between students taught Geometry using video-aided instruction and those taught using the diagram-aided instruction. It shows that the Pre-GAT mean score of students who learned using the Video-aided instruction was 36.47, SD=7.47 whereas their mean Post-GAT was 68.92, SD=9.29 and their mean Gain-GAT score was 32.16, SD=9.17. On the other hand, the Pre-GAT mean score of students who taught using the diagram-aided instruction (DAI) was 34.86, SD=7.22 whereas their mean Post-GAT was 54.71, SD=5.60 and their mean Gain-GAT score was 18.86, SD=5.30.

Table 4: Summary of descriptive statistics on the difference in the learning achievement between the male and the female students taught Geometry using video-aided instruction (VAI)

		Pre-GAT		Post-GAT		Gain-GAT	
Gender	N	Mean	SD	Mean	SD	Mean	SD
Male	24	36.67	7.76	67.29	9.55	30.63	9.59
Female	13	36.92	7.23	71.92	8.30	35.00	7.91

The result from Table 4 shows the summary of descriptive statistics on the difference in the learning achievement between the male and the female undergraduate students taught Geometry using video-aided instruction. It shows that the Pre-GAT mean score of male students who learned using the video-aided instruction was 36.67, SD=7.76 whereas their mean Post-GAT was 67.29, SD=9.55 and their mean Gain-GAT score was 30.63, SD=9.59. On the other hand, the Pre-GAT mean score of female students who taught using the same method was 36.92, SD=7.23 whereas their mean Post-GAT was 71.92, SD=8.30 and their mean Gain-GAT score was 35.00, SD=7.91.

Table 5.: Summary of ANCOVA on the difference in the learning achievement between undergraduate students taught Geometry using the VAI and those taught using DAI

Source	SS	Df	MS	F	Sig.	η^2
Corrected Model	5203.062[a]	2	2601.531	57.371	.000	.624
Intercept	5122.713	1	5122.713	112.969	.000	.621
Pre-GAT	1045.017	1	1045.017	23.045	.000	.250
Treatment	3568.845	1	3568.845	78.702	.000	.533
Error	3128.882	69	45.346			
Total	280900.000	72				
Corrected Total	8331.944	71				
a. R Squared = .624 (Adjusted R Squared = .614)						

The result from Table 5 shows the summary of ANCOVA on the difference in the learning achievement between undergraduate students taught Geometry using the video-aided instruction and those taught using diagram-aided instruction. The result indicated an F-calculated value of 78.702, p-value of 0.00 and η^2 =0.533. This shows a moderate Partial Eta effect-size value of 53.3%. The result established that there is a significant difference in the learning achievement between undergraduate students taught Geometry using the video-aided instruction and those taught using the diagram-aided instruction ($F_{1, 69}$=78.702, p=0.00). The null hypothesis two was rejected at a .05 level of significance.

Table 6: Summary of ANCOVA on the difference in the learning achievement between the male and the female undergraduate students taught using the VAI

Source	SS	Df	MS	F	Sig.	η^2
Corrected Model	714.019[b]	2	357.010	5.073	.012	.230
Intercept	3649.823	1	3649.823	51.863	.000	.604
Pretest	533.144	1	533.144	7.576	.009	.182
Gender	170.661	1	170.661	2.425	.129	.067
Error	2392.738	34	70.375			
Total	178850.000	37				
Corrected Total	3106.757	36				
a. Treatment = VAI						
b. R Squared = .230 (Adjusted R Squared = .185)						

The result from Table 6 shows the summary of ANCOVA on the difference in the learning achievement between the male and the female undergraduate students taught Geometry using the Video-aided instruction. The result indicated an F-calculated value of 2.425, p-value of .129 and η^2 =0.067. This shows a low Partial Eta effect-size value of 6.7%. The result established that there is no significant difference in the learning achievement between the male and the female undergraduate students taught Geometry using the Video-aided instruction ($F_{1, 34}$=2.425, p=0.129). The null hypothesis six was retained at a .05 level of significance.

Discussion of findings

The result from Table 3 showed the students who learned using the VAI and those taught using the DAI varied in the gain-GAT mean score of 13.30. When put to the statistical test, the ANCOVA results from Table 4.5 showed a moderate Partial Eta effect-size value of 53.3%. The result established that there is a significant difference in the learning achievement between undergraduate students taught Geometry using the Video-aided instruction and those taught using the diagram-aided instruction ($F_{1, 69}$=78.702, p=0.00), in favour of the undergraduate students taught Geometry using Video-aided instruction. The null hypothesis one was rejected at a .05 level of significance. This finding is in agreement with an earlier finding of (Onah et al., 2020; Ukaigwe & Goi-tanen, 2022; Gongden & Gongden, 2019; Enikanolaye, 2021; Abuton, 2022; Onasanya et al., 2022; Nwaokolo et al., 2022; Akinoso, 2018; Ikwuku & Adigwe, 2021; Simkhada, 2021; Oraneto & Omile, 2021) which established that there is a significant difference in the learning achievement between students taught Mathematics using the video-aided instruction and those taught with a conventional instructional method in favour of the experimental group.

The result from Table 4 showed that the mean variation in the gain-GAT scores between the male and the female graduate students who learned using the VAI was 4.37. When put to the statistical test using the ANCOVA the

result from Table 4.6 showed a low Partial Eta effect-size value of 6.7%. The result established that there is no significant difference in the learning achievement between the male and the female undergraduate students taught Geometry using the video-aided instruction ($F_{1, 34}$=2.425, p=0.129). The null hypothesis two was retained at a 0.05 level of significance. This finding is in agreement with an earlier finding of (Nonyelu & Anikweze, 2019; Obielodan et al., 2022; Nwaokolo et al., 2022; Enikanolaye, 2021; Gongden & Gongden, 2019; Yaki & Babagana, 2016; Akinoso, 2018; Gambari et al., 2016; Furo, 2015) which established that there is no significant difference in the learning achievement between the male and the female students in Mathematics. The finding is however in disagreement with an earlier study (Egbunu et al., 2017; Safo et al., 2015; Olatayo et al., 2017) which found that there is significant difference in the learning achievement between the male and the female students in Mathematics.

Conclusion

Students' learning achievement in geometry needs much to be desired following it effects of these on students' academic development. Findings from researchers in geometry has established students' appalling learning achievement in geometry as a result of the abstract nature of the geometry, students' enmity towards the study of geometry and their perception that the study of geometry is difficult among other factors. In consequence of the factors militating against successful outcomes in the learning of geometry the video-based instruction was adopted by the researcher to probably ameliorate students' learning achievement in geometry. The result of the study revealed positive effects of the video-aided instruction on undergraduate students' learning achievement in geometry irrespective of gender. Besides, the effective use of the video-aided instruction showed that students' learning achievement in geometry fails to depend on gender. Also the study's findings emphasized that there is no statistical difference in the intellectual ability in learning geometry based on gender. Similarly, the result of the study as well indicated that the video-aided instructions are capable of reducing the abstract nature of geometry to promote students' learning outcomes, eradicates students' perceived difficulties of the discipline, and minimized teacher's challenges of explaining abstract geometric concepts. It is consistent to conclude that the appropriate use of the video-aided instructions in teaching geometry to students enhanced their learning achievement in geometry and equally eradicated male and female students' inequalities in learning achievement in geometry.

Recommendations

Based on the findings of the study, the following recommendations were made;

1. Video-aided instruction could be used in facilitating geometry teaching in Colleges of Education, and if possible Senior/Junior High Schools and primary schools.

2. Video-aided instruction may similarly be used in geometry teaching to avoid or minimize male and female students' discriminations in learning achievement.

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