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ACHIEVEMENT THROUGH GEOGRAPHIC INFORMATION SYSTEM (GIS) AND INTEREST OF JALINGO SECONDARY SCHOOL STUDENTS IN GEOGRAPHY: QUANTITATIVE ANALYSIS

EDWIN, AYANA CHRINUS
Department of Environmental Management, Faculty of Management Sciences, Nnamdi Azikiwe University Awka, Anambra State, Nigeria.

Abstract

This study focused on the effect of Geographic Information System on Geography achievement and interest among secondary school students in Jalingo, Taraba State. The study was guided by two research questions and two hypotheses. It was an experimental research design involving 107 sample size out of 740 target population using simple random sampling technique while purposive sampling method was employed to select intact SSII students from 3 secondary schools in the study area. The respondents were divided into experimental and control groups whereby 4-week treatment was conducted on experimental group with GIS tools while control group was taught with conventional teaching method. Two instruments- Geographic Information System in relation to Geography Performance Test- GISGPT and Geographic Information System in relation to Geography Interest Rate- GISGIR. The instruments yielded reliability coefficient of .89 and .82 for GISGPT and GISGIR respectively using Cronbach's Alpha. The data collected were analyzed using mean and standard deviations for answering research and analysis of covariance-ANCOVA to test hypotheses at 0.05 level of significance. The findings revealed that there is significant difference in the mean achievement scores of the students taught Geography with GIS tools and students taught with CTM; and there is significant difference between the mean interest rate of students taught Geography with GIS tools and students taught using CTM. Based on the findings of the study, it was concluded that GIS tools have significant effect on academic achievement and interest of Geography students in the study area. Therefore, it was recommended among others that Geography teachers should be trained and encouraged to include GIS utilization rather than CTM that does not improve on achievement of Geography students.

Keywords:
Geographic Information System, Academic Achievement, Geography, Secondary Students, Jalingo.

Introduction

The environmental changes have necessitated the study of environment and man's relationship with environment. One of the environmental science courses that concerns with the study of environment is Geography. According to Suleiman (2017), Geography is a

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distinct and dynamic science and social science discipline that deals with the study of man and physical environment. Among others the author identified the importance of geography to include but not limited to equip a body of knowledge to make students functionally and socially relevant in the fast-changing world; to appreciate the value of environment and its vast natural resources; and to appreciate and develop a sense of responsibility towards society at large. In other words, the scope of geography as a field of study covers the diverse environments, places and spaces of the earth's surface and its interactions.

This is based on the feelings that Geography is one of the most important subjects in secondary school that equips a body of knowledge to make students functional in life (Kerski, 2014). For Gilbert (2012), studying Geography enables students to understand and do something about some of the issues and problems facing the society and the world including climate change, energy dependence, war and regional conflict, globalization and international terrorism. Akintade (2013) averred that Geography as a subject, builds on students' experiences, helping to formulate questions, develop intellectual skill and find answers to issues affecting lives as it introduces learners to distinctive investigative tools such as maps, fieldwork, and use of powerful communication technologies. Simply put, if Geography is properly taught, it inculcates a wide range combination of skills, drawing ideas from numerous sources so as to instill a wider perspective.

Moreover, Shaibu (2014) identified inappropriate pedagogical approach as one of the factors responsible for persistent poor performance in Geography by secondary school students in the north-central, Nigeria. Similarly, Ling and Boo (2013) observed that pedagogical method of teaching science in secondary schools is informative and does not engage students' active participation. That is, the teaching technique encourages passive learning and forming of misconceptions by students which influence how they interpret and construct new knowledge. For Kunter (2012), the instructional method affects non-cognitive aspects, which include motivational orientations such as interest in Geography. To this end, instructional method does not only affect academic performance of students but also their attention and interest in Geography lessons. In support of this, Krapp (2012) described interest as stressed person-object-relation, which is marked by the features of cognition, emotion and valence. Hence, pedagogical approach is closely linked to psychological expression of knowledge acquired in terms of academic performance as well as psychological disposition of learners' interest in Geography.

However, owing to technological advancement and happenings in the 21st century society, meaningful teaching techniques are becoming more important for teaching Geography; to keep abreast of these developments and happenings as they relate to process of learning. In fact, scholars like Akeju et al. (2015) and Gallenstein (2013) have shown the efficacy of innovative teaching strategies in reforming the way Geography is being taught at secondary school level. By implication, the rapid technological development has given opportunities to production of several devices, gadgets and tools that can be used in the field of education.

Accordingly, it is necessary to know the technology options to be used in teaching Geography to enable student benefit optimally. In spite of different technology options for teaching Geography, Akkus (2014) maintained that Geographical Information System (GIS) is a flexible tool that can be contoured in accordance with instructional objectives. This is because GIS contains both layers of graphics (that is, maps of rivers and farms) and corresponding attributes stored in a table for proper coordination of information. In this wise, GIS is a model of the real world, which enables

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different graphics as well as professional views on a dataset (De Lange, 2017). For Falk (2014), GIS is a combination of elements designed to store, retrieve, manipulate and display geographic information about places. In other words, GIS as a package consists of four basic parts: robust hardware, powerful software, special data, and a thinking explorer. This explains why Bednarz (2012) construed GIS as a complete package that covers everything relevant to 'Geography' and teaching-learning process in Geography class- for instance content, methods, objectives as well as persons and their relationships. To this end, when GIS is effectively utilized, it activates students from passive position and gives various skills such as spatial perception, tech- savvy, geographic analysis, and cartographic skills (Tabanli, 2014). Hence, GIS injects skills that improve students' attitude, motivation and success towards the lessons especially in Geography subject in a positive way. This assertion is supported by studies that have reached the conclusion that GIS impact students' academic success in Geography positively (see Balciogullari, 2011; Cin & Tabanli, 2015; Iwan & Sugandi, 2019).

Moreover, studies have shown that GIS improves students' interest towards Geography class by increasing the relevance of the subject to the students (West, 2013). This shows that GIS attracts students' attention and interest to Geography and by extension, the use of GIS in Geography classroom is essential to sustainability of learners' interest. Despite the increased interest in GIS-classroom, there is conversation concerning appropriate use of GIS in Geography classroom to attract students' interest. Researchers like Baker (2015) identified lack of technical know-how on the part of instructor, inherent complexity of GIS, and time spent on teaching GIS at the expense of contents of lesson are barriers to retain students' interest when GIS is applied in Geography lesson. Simply put, many Geography teachers do not have basic knowledge to operate GIS; as such it is difficult for them to impact knowledge not to talk of retaining students' mental state.

However, it is obvious that GIS and GM tools have become pervasive that they are emerging in secondary school education and being integrated into Geography classes in a number of countries (Oppong & Ofori-Amoah, 2012). Aladag (2015) asserted that 73% of high schools in Capricorn district municipality of Limpopo South Africa integrated GIS and Earth Map into teaching of Geography in senior high school. Whereas Kaya's research on the level of GIS integration in Geography class revealed 81% (very high level) integration in senior class and 65% (high level) integration in science in junior class across public schools in Bogoma district of Kenya (Kaya, 2012). Besides, Artvinli (2013) asserted that introduction of GIS and Earth Map in Geography classes has a positive effect on academic performance and students' interest towards Geography lessons. However, little has been said about GIS integration in science subjects in public secondary schools in Taraba State. In order to provide updated information in this direction, the current study investigated the effect of Geographic Information System (GIS) academic performance and interest of Geography secondary school students in Jalingo, Taraba State, Nigeria.

Statement of the Problem

One of the determining factors of teacher's performance is the students' academic performance in a particular subject. That is, when students have good academic performance, it means teachers are doing their work diligently. In order to boost students' academic performance in public secondary schools in Taraba State, the state government usually engages services of qualified and experienced teachers through 'Rescue Teacher Programme'. But recently, students' performance in national examinations (WAEC, NECO, and NABTEB) in science related subjects especially

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Geography has not been impressive. This is partly attributable to traditional instructional method used by Geography teachers whereby students are being taught with paper maps at the expense of modern tools such as Geographic Information System (GIS). In order to discontinue unimpressive performance in Geography subject, the current study examined the effect of integration of GIS tools in Geography class on academic performance and interest of students.

Purpose of the Study

Generally, the study aimed to examine the effectiveness of Geographic Information System (GIS) and its effects on performance and interest of secondary school students in Geography in Jalingo, Taraba State. Specifically, the study sought to ascertain;

1. Effect of Geographic Information System (GIS) on performance of secondary school students in Geography in Jalingo, Taraba State.
2. Effect of Geographic Information System (GIS) on interest of secondary school students in Geography in Jalingo, Taraba State.

Research Questions

The following research questions were formulated to guide the study:

1. What is the mean performance score of students in Geography exposed to Geographic Information System tools and students taught using Conventional Teaching Method?
2. What is the mean Interest rate of students taught Geography using Geographical Information System tools and students taught using Conventional Teaching Method?

Research Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

H_{O1}: There is no significant difference in the mean performance scores of the students taught Geography using Geographical Information System tools and students taught using Conventional Teaching Method.

H_{O2}: There is no significant difference between the mean interest of students taught Geography using Geographical Information System tools and students taught using Conventional Teaching Method.

Literature Review

The inclusion of multimedia technology to classroom activities has contributed immensely to student's learning and academic performance. Klein (2017) affirmed that GIS in the classroom has different functions, namely conveying information about non-accessible areas, helping in the visualization and analysis of geographical topics, facilitating students' learning, providing opportunities for the individualized support of students, enabling the acquisition and exercise of tech competencies, aiding communication, influencing the students' interests, emotions as well as motivating them and preparing students for the job market and participation in society. However, GIS is not a substitute for real world experience, but students need actual experiences in order to apply virtual technologies with a critical perspective and ethical practice (Cremer, 2014). Hence, GIS provides opportunities for students to have factual knowledge of technological application to solving real life experiences.

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The assertion above explains why Crews (2013) conceives GIS as a form of representation for portraying discrete or continuous spatial phenomena and their temporal change. GIS in various degrees of complexity serve the acquisition, management, analysis and presentation of geo-factors or geo-objects and their geo-data in the integrative interrelationship of physical, biotic and human issues and play a significant role in acquiring geographic system competency. In other words, GIS has multi-functional tendencies such as interactivity, the layer principle and the possibilities for adapting complexity and or capabilities for analysis. Obviously, GIS features may likely lead to a positive effect on students' academic performance when GIS is integrated into teaching of geography. In support of this, Yarden and Abraham (2016) revealed a positive and significant relationship between academic performance of students and use of GIS in internal geography examination. Klein (2017) reported 54.7% of respondents who agreed that their geography teacher apply GIS, which has positively increased classroom participation and engagement of students in Southern Kenya while the remaining 46.3% affirmed to the use of atlas/maps, and geography textbook. Similarly, the study conducted by Roberts (2013) indicated that the use of GIS in geography classroom improves learning process in the following ways: making it more lasting and effective (46%), as well as simplify and augment geographic investigations (54%). It further revealed that GIS changes the way content is being taught and learned by making teaching more collaborative and inquiry-based (51%), and enabling a different way of analysis (49%). Based on these studies, it may be asserted that GIS is significant to teaching and learning of geography in secondary schools.

Again, one of the ways to break the boredom and fascinate students' attention during lesson is to introduce technological gadget. In this context, GIS is said to fill the gap with its potential to enhance learning by creating a student-centered inquiry environment, creating links between policy and science to help students solve real-world problems, enhancing interdisciplinary learning, enabling students to use the same tools as professionals, and being accessible to a wide range of learners (National Research Council NRC, 2016). These functions of GIS in education seem to meet the NRC's recommendations for effective learning, which include creating an environment that is student-, knowledge-, assessment-, and community-centered (NRC, 2019). In fact, West (2013) surmised that GIS has the potential to improve students' interest by increasing the relevance of the subject to the student-life experience. That is, GIS prepares students to be more relevant in today's society since technological knowledge is of great importance to present generation.

In support of the statement above, Gewin (2014) contend that the use of GIS is increasing globally in a wide variety of fields with a growing demand for trained GIS specialists. In this sense, integration of GIS into lesson delivery in Geography is a means of preparing students for the job world thereby arousing students' interest in Geography class. Gewin claimed, for those students who were taught under GIS instruction, they tend to have interest in becoming GIS specialist owing to availability of jobs for GIS expert (Gewin, 2014). To this end, beyond attracting student interest in Geography class, GIS has great importance over subject boundaries.

Turkuresin (2021) conducted a study on effect of using technology in education on academic achievement of students: The case of Geographical Information System. The study aimed at determining the effect of Geographic Information Systems on the academic performance of students in science and technology in Meru district of Kenya. The study focused on 4,890 penultimate science and technology tertiary institution students across Meru district, Kenya. In order to achieve the objective of the study, meta-analysis method was used while simple random

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sampling technique was used to 620 and 607 for experimental and control groups. Questionnaire and Science and Technology Achievement Test were used as instruments for the study. The data collected were analyzed using Q and P significance test at 0.05 p-value. The findings revealed that GIS has a very wide (+1,193) effect on academic achievement of science and technology students while the positive average effect size indicates a change in favour of the experimental group. It was therefore recommended that GIS should be integrated into science and technology courses in all tertiary institutions so as to enhance on academic performance of students in the study area and Kenya as a whole. Thus, it was concluded that GIS has wide positive effect on academic achievement of science and technology students in the study area.

Singh, Rathakrishnan, Sharif, Talin and Eboy (2016) conducted a study on effect of Geographic information system (GIS) based teaching on underachieving students' mastery goal and achievement among high schools in Turkey. The study used mixed research method to determine the effect of GIS based teaching on underachieving students' achievement and motivation to learn Geography. Qualitative data were sought through interviews while experimental design was used to obtain quantitative data. Simple random sampling technique was used to select 140 students comprising 84 treatment group and 66 students in control group from 1450 target population for the study. The two groups were taught the same topics but with GIS and traditional method for treatment and control groups respectively. Concurrent triangulation model was used to analysis the quantitative data. The findings revealed that mastery goal and achievement post-test mean score of experiment group participants are significantly higher than control group participants. The evaluations of student participants' interviews are consistent with quantitative findings. The triangulation of the quantitative and qualitative data reveals that GIS-based teaching had a more positive effect as compared to traditional teaching methods in enhancing students' mastery goal learning, motivation and achievement in the topics being taught. The study recommended that GIS tools should be used in teaching geography so as to motivate and improve on academic achievement of students. The study therefore concluded that GIS based teaching has positive effect on students' achievement and motivation to learn Geography.

Atandi (2013) carried out a study on geographic information system integration in monitoring and evaluation of students' performance in Kenya. Among others, students' performance progress tracking is the centrality of this study. The research design was descriptive, targeting a total population of 1,830 students of Geology students across three government owned universities with a sample size of 125 penultimate students. Purposive sampling technique was used to select 300 level students to serve as respondents for the study. Data collection was done by use of online self-administered questionnaires and quantitative data was analyzed using descriptive (frequencies, percentages, means and standard deviations) and inferential statistics (linear regression analysis) to test the hypothesis and results presented in tables and charts with the aid of Statistical Package for Social Sciences (SPSS). The findings revealed GIS progress tracking had a positive correlation and significantly influenced performance of students; GIS data integration had a positive correlation and significantly impacted the performance of students; and that GIS information sharing had a positive correlation and significantly influenced performance of students. The study further showed that GIS data sharing positively and significantly influenced performance of students; and that GIS data management also positively and significantly influenced performance of students in the areas of field work, practical classes, conduct and implementation of individual assignment/project. The study concluded that academic institutions

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needed to include GIS data management skills in their programmes to enable environmental students to collect, analyze and interpret GIS data for proper decision making. The study recommended that GIS should be factored in the curriculum of environmental programmes (e.g., geology, geography, social studies, etc) with emphasis on GIS in progress tracking to ensure good performance of students.

However, the relevance of GIS for improving students' interest in classroom activities has been documented by various scholars. This is supported by Baker (2012) that the number of empirical studies dealing with the impact of GIS use on students' interest is growing and already spans a wide variety of contexts and objectives. However, the number of empirical studies is especially limited with regard to Geography. Available studies seem to indicate a strong influence of use of GIS on students' interest in gadget mainlining rather than specific field of knowledge. For example, Falk (2015) revealed that instruction in GIS class helps students to look at a topic from multiple perspectives and gain some insight into interdependencies, whereas they lack background knowledge to use gadget in other subjects. This shows that GIS class is attractive and interesting to students in several ways thereby informing them on how to integrate modern gadget to other subjects of study.

Suleiman (2015) carried out a study on contribution of geographical information system (GIS) to Geography education and secondary school students' interest in Instanbul, Ankara. The study aimed at establishing whether GIS contribute to the development of Geography education and students' interests towards Geography. It was a descriptive research design with 665 sampled respondents selected from 6,549 target population using stratified sampling technique. The data were gathered using the scale of attitude determinant and structured questionnaire. The data obtained were analyzed using means, standard deviations, t-test, and Pearson Product Moment Correlation- PPMC. The outcomes revealed positive students' interest in Geography and that GIS contributes positively towards development of Geography education in the study area. This is noticed in daily increasing number of students that offer geography across the region as well as the numbers that have registered interests in studying geography at the university level.

Rosenzweig, Bhaskar and Shishodia (2018) investigated the impact of using geographic information system on students' interest in epidemiology. The study aimed at enhancing students' understanding of epidemiology and disease spread and to attract students' interest to earn a GST certificate making them more marketable in an increasingly competitive workplace. In order to achieve the objectives of the study, two research questions and research hypotheses guided the study. It was ex-post facto research design involving 86 selected epidemiology students out of 708 total population. Following a 25-mnute introductory GIST infusion lecture during a microbiology class session, a 1.5-hour GIST laboratory exercise was performed in which teams of students evaluated Centers for Diseases Control (CDC) chlamydial disease incidence data. Questionnaire and a map of ArcGIS software served as instruments for data collection. A pre- and post-infusion of GIST data was carried out to determine the efficacy GIST. The data was analyzed using descriptive statistics and Chi-square analysis as deemed appropriate. The study showed significant effect of GIST in attracting students' interest towards the likelihood of further GIST study leading to a certificate program, and by exposing biology undergraduates to GIST technologies and software, enabling student data mapping. It was recommended that GIS tools should be adapted in medical science disciplines as deemed appropriate in order to prepare graduate with needed skills in the work place. The study concluded that GIST in epidemiology is capable to promote vocationalization

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of biology programme, thereby enhancing and broadening employment opportunities for graduates.

Wei (2012) did research on the application of geographic information system in increasing students' interests in business management in Uganda. This study is predicated on the fact that GIS has basic features that increase its usability in managing business environment which must be learnt by students in Business Management, Training Institute, Uganda. Four research questions and hypotheses guided the study while questionnaire was used for data collection from the selected 180 sampled respondents using simple random sampling technique out of 1,680 total population. Frequency and percentage were used for answering the research questions while pie-chart and bar chart were used for representing hypotheses test for the study. The study revealed that GIS itself is information system offering services to Business environment and decision-making, which can play a role in business management. Also, the findings indicated that GIS attracts students' interests to business management in different ways such as data collection, storage, processing, spatial analysis and so on; and that GIS directly provides services for business management, thereby increasing students' interests in the field. The study recommended the use of BGIS to inculcate technological know-how into students in terms of ability to produce a comprehensive thematic map as skills imparted in GIS integrated business management class. The study concluded that GIS application in business management helps students to possess in-depth knowledge of panoramic view of the current technology and management system with ability to work around construction of business geographic information database, establishment of data structure and the data model as well as design of geographic information database system.

Jafar, Farnia and Velayat (2017) conducted a study on impact of geographical information system on students' interest in public health sciences. The study aimed at unraveling beneficial influence of GIS in the field of health sciences so as to attract and sustain students' interest. In order to achieve the stated objectives, two research questions and hypotheses guided the study involving 210 randomly selected health science students out of 1,020 total population in the faculty of public health, University of Kampala. It was an experimental research design involving two groups (control and treatment) using split-half method. Having exposed the treatment group to how GIS is used to do mapping and visualizing of disease distribution, which is very interesting to health practitioner as it improves the understanding of disease diversities and spatial patterns. The GIS software with medical applications for monitoring and assessing the effects of environmental factors (namely, population, air pollution, location, climatic changes) on public health problems was used as instrument for gathering participants' opinions as to whether GIS boost students' interest in public health sciences or not. The data collected was analyzed using Pearson Product Moment Correlation to indicate the extent at which GIS stimulates students' interest in public health sciences. The findings revealed that GIS stimulates students' interest in public health sciences at very high extent (VHE) especially in the area of mapping of diseases, visualizing of disease distribution, and understanding disease diversities as well as their spatial patterns. It was recommended that GIS tools should be made available for proper teaching and learning of health science students. The study concluded that GIS stimulates students' interest in public health sciences by providing intra-and inter-logical connection between health, social services and social environment.

Methodology

Research Design

The study adopted quasi experimental research design, which is an established technique to determine cause and effect relationships (Fraenkel, Wallen & Hyun, 2012). The quasi-experimental design was used in this study to administer different instructional methods (GIS and Traditional Method) in order to determine the effect on students' performance and interest in Geography.

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Population

The population for this study was 340 Geography students in 21 public secondary schools across Jalingo local government area of Taraba State. Available record from the Taraba State Post Primary Schools Management Board (2023) revealed 340 Geography students across public secondary schools in Jalingo LGA, Taraba State.

Sample and Sampling Technique

The sample size for this study was 107 drawn from the 3 schools out of 14 schools that offer Geography in Jalingo LGA. Simple random sampling technique was used to select 3 secondary schools while intact SSII classes were used in the selected schools.

Instrument

Two instruments (Geographic Information System in relation to Geography Performance Test-GISGPT and Geographic Information System in relation to Geography Interest Rate- GISGIR) were used for data collection for this study. GISGPT is a 20-item self-developed instrument designed to measure student participants after exposing them to some Geography topics with GIS tools. GISGPT was used to evaluate students' performances before and after 4 weeks of intervening period. That is, these instruments served for pretest (before teaching with GIS tools) and posttest (after teaching with GIS tools). Also, GISGIR was adapted and cultured to serve the purpose of this study.

Validity and Reliability

The instruments were given content and face validation in terms of clarity of purpose, relevance of the subject matter, coverage of content areas, appropriateness of language usage and appropriateness of the instrument to the respondents, which made them valid instruments. In order to ascertain the internal consistency of the instruments, pilot study was conducted on 30 Geography students in a secondary school outside the study area, Cronbach's Alpha was used to analyze the data obtained, which yielded .89 and .82 coefficient for GISGPT and GISGIR respectively.

Analysis

The data collected were analyzed using mean and standard deviations for research questions and analysis of covariance (ANCOVA) to test the null hypotheses at 0.05 level of significance.

Results

Research Question 1: What is the mean performance score of students in Geography exposed to Geographic Information System tools and students taught using Conventional Teaching Method?

Table 1: Mean performance scores and standard deviations of students taught geography using GIS and those taught using the CTM

Group	N	Pretest		Posttest		Mean gain	Adjusted Mean
		mean	std. dev	mean	std. dev		
GIS	57	9.55	4.37	15.30	4.46	5.75	14.17
CTM	50	4.92	2.27	7.22	2.38	2.30	9.61
Mean difference			4.63		8.08	3.45	4.56

Source: Field Study (2024)

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Table 1 shows that the posttest mean score of students taught using GIS tool is 15.30 with standard deviation of 4.46, while those taught using CTM have mean score of 7.22 with standard deviation of 2.38. The difference between the pretest and posttest mean scores of GIS group is 5.75, while that of the CTM group is 2.30. The pretest and posttest performance mean score differences for the two groups shows that the GIS group is higher. After the effect of the pretest has been statistically removed, the adjusted (posttest) mean score of students in the GIS group stands at 14.17, while that of their counterparts in the CTM group is 9.61. The difference between the adjusted mean score of students in the two groups (GIS and CTM) is 4.56. Both the mean gain scores difference and the adjusted mean scores difference is high, and in favour of the GIS group. This suggests that students taught using GIS achieved higher than their counterparts taught using CTM.

Research Question 2: What is the mean Interest rate of students taught Geography using Geographical Information System tools and students taught using Conventional Teaching Method?
Table 2: Mean and Standard Deviation of Interest rate of Students taught Geography using Geographical Information System and Conventional Teaching Method

Method		Pre-Interest	Post-Interest	Mean Gain
GIS	Mean	2.66	2.98	0.32
	N	57	57	
	Std. Deviation	.415	.509	
Conventional Teaching Method	Mean	2.45	2.72	0.27
	N	50	50	
	Std. Deviation	.36	.49	
Mean difference		0.21	0.26	0.05

Source: Field Study (2024)

Table 2 shows the difference in the mean Interest rate of students taught Geography using Geographical Information System and those taught using Conventional Teaching Method. The table shows that 57 students were taught using Geographical Information System and 50 students were taught using Conventional Teaching Method. The table reveals that the mean Interest rate of students taught Geography using Geographical Information System is 2.66 with a standard deviation of 0.42 during pre-test and 2.98 with a standard deviation of 0.51 in posttest. The mean Interest rate of students taught Geography using Conventional Teaching Method is 2.45 with a standard deviation of 0.36 during pre-test and 2.72 with a standard deviation of 0.49 in posttest. The table reveals a pretest and posttest mean difference of 0.21 and 0.26 respectively. The table further shows that the mean interest gain of students that were taught Geography using Geographical Information System is 0.32 and those of students taught Geography using Conventional Teaching Method is 0.27. The difference in the mean Interest rate of students taught Geography using Geographical Information System and those taught using Conventional Teaching Method is 0.05 in favour of students taught Geography using Geographical Information System.

Testing of Hypotheses

Research Hypothesis One (H_{01}): There is no significant difference in the mean performance scores of the students taught Geography using Geographical Information System tools and students taught using Conventional Teaching Method.

Table 3: Results of two-way analysis of covariance of instructional strategies and gender on students' performance in Geographical Information System.

Sources of Variation	Sum of Squares	df	Mean Square	F	Sig	Partial Eta squared
Corrected Model	3529.298[a]	4	882.324	127.817	0.000	0.773

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Intercept	1033.046	1	1033.046	149.652	0.000	0.499
Pretest	1210.657	1	1210.657	175.381	0.000	0.539
Gender	5.224	1	5.224	0.757	0.386	0.005
Method	532.580	1	532.580	77.152	0.000	0.340
Error	1035.45	1	150	6.903		
Total	29.552.00	0	155			
Corrected Total	4564.748		154			

Source: Field Study (2024)

Table 3 is a two-way between group's analysis of covariance to compare the effect of (GIS and CTM on students' performance in Geography. After adjusting for the pre-test scores, there is a significant difference between the two groups on students' posttest scores F (1,152) = 77.152, p = 0.00, with large effect size (partial eta squared = 0.340). The effect size shows that only 34% of the variance in performance scores of the students is based on the method used. Similarly, there was a strong relationship between the pretest and posttest scores on the students' performance test, as indicated by a partial eta squared value of 0.539. Thus, the hypothesis of no significant difference between the mean performance scores of the students taught Geography using Geographical Information System (GIS) and students taught using conventional teaching method is hereby, not retained. Therefore, there is significant difference between the mean performance scores of the students taught Geography using GIS tools and students taught using conventional teaching method in favour of experimental group (GIS-class).

Research Hypothesis Two (H_{02}): There is no significant difference between the mean interest of students taught Geography using Geographical Information System tools and students taught using Conventional Teaching Method.

Table 4: ANCOVA of Mean interest rates of students taught Geography using Geographical Information System and students taught using Conventional Teaching Method
Dependent Variable: Post Interest

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2.708[a]	2	1.354	5.362	.006	.067
Intercept	23.019	1	23.019	91.166	.000	.378
Pre-Interest	.276	1	.276	1.093	.297	.007
Method	1.901	1	1.901	7.530	.007	.048
Error	37.874	150	.252			
Total	1295.140	153				
Corrected Total	40.582	152				
a. R Squared = .067 (Adjusted R Squared = .054)						
Source: **Field Study (2024).**						

Table 4 reveals that F(1,150) = 7.530; p = 0.007 < 0.05. Thus, the null hypothesis is rejected. This implies that there is significant difference between the mean Interest rate of students taught Geography using Geographical Information tools and those taught using Conventional Teaching Method. Thus, it can be concluded that based on evidence from data analysis there is significant difference between the mean Interest rate of students taught Geography using GIS tools and students taught using CTM in favour of experimental group (GIS-class).

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Discussion of Findings

Table 1 shows that the posttest mean score of students taught using GIS teaching method is 15.30 with standard deviation of 4.46, while those taught using CTM have mean score of 7.22 with standard deviation of 2.38. The difference between the pretest and posttest mean scores of GIS group is 5.75, while that of the CTM group is 2.30. The pretest and posttest performance mean score differences for the two groups shows that the GIS group is higher. After the effect of the pretest has been statistically removed, the adjusted (posttest) mean score of students in the GIS group stands at 14.17, while that of their counterparts in the CTM group is 9.61. The difference between the adjusted mean score of students in the two groups (GIS and CTM) is 4.56. Both the mean gain scores difference and the adjusted mean scores difference is high, and in favour of the GIS group. This suggests that students taught using GIS achieved higher than their counterparts taught using CTM.

The findings agree with studies conducted by Turkuresm (2021), which revealed that GIS has a very wide effect on academic achievement of science and technology students and the positive average effect size indicates a change in favour of the experimental group. The findings from this study is in agreement with Singh, Rathakrishnar, Sharif, Talin and Eboy (2016) who reported that mastery goal and achievement post-test mean score of experiment group participants are significantly higher than control group participants. The current study also concurs with Atandi (2013) whose findings revealed that GIS progress had a positive correlation and significantly influenced the performance of students; GIS data integration had a positive correlation and significantly impacted the performance of students; and that GIS information sharing had a positive correlation and significantly influenced performance of students.

Table 3 shows the difference in the mean Interest rate of students taught Geography using Geographical Information System and those taught using Conventional Teaching Method. The table shows that 35 students were taught using Geographical Information System and 33 students were taught using Conventional Teaching Method. The table reveals that the mean Interest rate of students taught Geography using Geographical Information System is 2.66 with a standard deviation of 0.42 during pre-test and 2.98 with a standard deviation of 0.51 in posttest. The mean Interest rate of students taught Geography using Conventional Teaching Method is 2.45 with a standard deviation of 0.36 during pre-test and 2.72 with a standard deviation of 0.49 in posttest. The table reveals a pretest and posttest mean difference of 0.21 and 0.26 respectively. Table 3 further shows that the mean interest gain of students that were taught Geography using Geographical Information System is 0.32 and those of students taught Geography using Conventional Teaching Method is 0.27. The difference in the mean Interest rate of students taught Geography using Geographical Information System and those taught using Conventional Teaching Method is 0.05 in favour of students taught Geography using Geographical Information System.

The findings agree with the study conducted by Rosenzweig, Bhaskar and Shishodia (2018), which findings showed significant effect of GIST in attracting students' interest towards the likelihood of further GIST study leading to a certificate programme, and by exposing biology undergraduates to GIST technologies and software, enabling student data mapping. Also, the outcome of this study concurs with Jafar, Farnia and Velayat (2017) that GIS stimulates students' interest in public health sciences at very high extent (VHE) especially in the area of mapping of diseases, visualizing of disease distribution, and understanding disease diversities as well as their spatial patterns. Similarly, the current study supports the findings by Suleiman (2015) that GIS tools trigger positive students' interest in Geography and that GIS contributes positively towards development of Geography education in the study area. Additionally, the findings of the current study support Wei (2012) that GIS attracts students' interests to business management in different ways such as data collection, storage, processing, spatial analysis and so on; and that GIS directly provides services for business management, thereby increasing students' interests in the field.

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Recommendations

Based on the findings of this study, the following recommendations are made:

i. Geography teachers should be trained and encouraged to GIS tools rather than conventional teaching method that does not improve on academic performance of Geography students.
ii. Again, school management through the state ministry of education should provide modern teaching technological tools such as GIS to attract the interest of students in Geography education.

Conclusion

It is evident from the findings of this study that the use of Geographic Information System (GIS) could provide a good way for students to learn Geography, the study therefore concludes that there is a significant difference between the mean performance score of students taught Geography using GIS and Conventional Teaching Method (CTM). There is also a significant difference in the interest rates of students taught Geography using GIS and Conventional Teaching Method. Since there is significant improvement on students' interest and academic performance scores in GIS class, it is therefore concluded that GIS tools are viable to address the trend of poor academic performance of secondary school students in Geography.

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