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Effects of Connectivism-Based Jigsaw IV Strategy on Attitude and Performance in Geometry Concept among Secondary School Mathematics Students in Katsina State, Nigeria

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Abstract

This study investigated the Effectiveness of Connectivism-Based Jigsaw Strategy on Attitude and Performance in Geometry among Senior Secondary Students in Katsina State. Quasi-experimental research design was adopted. A total sample of 221 out of 77, 117 public senior secondary two (SS II) mathematics students during the 2025/2026 in Katsina state were selected using multistage sampling technique. Validated and tested Geometry Attitude Questionnaire (GAQ) and Geometry Performance Test (GPT) with the reliability coefficient of .79 and, .85 respectively were used for data collection of the study. All the research questions were answered using mean and standard deviation, while the hypotheses were tested using ANCOVA at .05 significance level. The findings revealed that the students taught geometry using Connectivism-Based Jigsaw IV Strategy (CONBJ4S) significantly performed better [$F(1, 436) = 53.02, p < .001$] with higher positive attitude towards geometrical concept [$F(1, 436) = 16.26, p < .001$] than their counterparts taught same concept using Conventional Lecture Method (CLM). Based on the study findings, it was recommended that mathematics teachers should adopt CONBJ4S in teaching geometry in place of the CLM commonly used in Katsina state.

Keywords: Connectivism, Jigsaw IV Strategy, Attitude, Performance, Geometry

Introduction

Nowadays, the wide spread of technology, instructional materials and cooperative strategy of different kinds in the discharge of teaching and learning process has resulted in the alteration of the learning environment, which brought about so many changes in the educational discharged (Downes, 2019). This has to do with the fact that, education is dynamic and go along with the discharge from traditional perspective to group and virtual learning where content to learn by the student can not only be guided by teacher but also discharged by students using technology and cooperative work to advance learning between and amongst themselves (Mubbireek, 2021). Additionally, Siemens (2021) argues that information technology has transformed the traditional learning environment in a significant way and observed that the different connection points in learning have been developed in learning where the use of cooperation and technology are used to create students' learning groups for interaction. This is done both in formal literacy and informal literacy within the wide learning environment that is becoming wider due to the prevalence of diverse technology platforms and group learning for discharging activities (Aldahdouh et al, 2015). Connectivism is a theoretical framework for understanding learning which emphasizes on how internet technologies and groups such as Online discussion forum, social networks and group learning contributed to new avenues of learning. In other words, it is a learning theory which explains how internet technologies and groups activities have created new opportunities for students to learn and share information among group members (Siemens, 2021). According to Yeppez (2021), learning was related to the group and virtual modality where Connectivism is strengthened as the construction of new knowledge through self-training with the use of technology or group work. Technology and cooperative work are changing students' learning in and out of classroom, rather than learning from teacher and textbooks. Smart phone, laptops and group work served as their means of getting information. The increase used of group work and technology as an educational tool, had changed the learning landscape. With it, came gaps in traditional ideas of teaching and need for new methods such as connectivism based cooperative learning strategies to keep-up, in order to tackle the global educational challenges. Jigsaw IV strategy, as cooperative learning approach, has demonstrated potential for promoting students' academic outcomes, particularly in challenging subject areas. The strategy engages students in collaborative activities where they learn specific material, teach it to peers, and collectively synthesize knowledge through group discussions and presentations (Aronson, 2023). Jigsaw IV technique is particularly important for complex topics like geometry in mathematics because of its organized stages, which include expert group discussions, quizzes, and re-teaching sessions. These phases enable deeper investigation of the material and close learning gaps (Gonzalez, 2015). As dependent variables, students' attitude towards geometry is their tendency to respond in a particular

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way towards geometrical concept (Sani et al, 2024). While, students' performance in geometry refers to their ability to demonstrate understanding of concept (Sani et al, 2025). Despite the importance of geometry, some students in Katsina state consider the concept as difficult and abstract. Such perceptions reduce their interest and participation in the lesson exercise leading to their poor performance and negative attitude towards the concept (Bada & Yusuf, 2022). These indicated that, students' performance and attitude have relationship and direct effect on one another (Klinedinst, 2023). That attributed due to conventional lecture method used by the teachers which make the students passive during the lesson (Adamu and Ibrahim, 2021). To tackle that, the researcher suggested to integrate connectivism principles (autonomy, diversity, openness and interactivity) with jigsaw IV strategy as Connectivism based jigsaw IV (CONBJ4) strategy in order to promote the students' attitude and performance in geometry in Katsina state.

Statement of the Problem

Students' performance and attitude towards geometry in secondary schools in Katsina state has decline despite its importance in mathematics and other sciences. Evidence indicated that geometry is one of the students' area of weakness (West African Examination Council [WAEC], 2023, 2024, 2025). Also, there is about 7.69% decrease in candidates' performance in Mathematics and English Language in WAEC 2024 compared to that of 2023 (Omisakin, 2024). Some factors contributing to the students' poor performance include; shortage of mathematics instructional materials, students' poor background on geometrical concept, improper implementation of curriculum by teachers were identified by Wasagu & Kabir (2022); Ibrahim et al (2023) and Dauda (2024). The use of conventional lecture method (teacher-centered method) which is not actively involving students in the learning process, predominantly used by teachers in the study area. Many students consider geometry as difficult concept due to its abstract nature (Adamu and Ibrahim, 2021). To address that, there is need to apply suitable method that promote the students' performance and attitude towards the concept, which inspire the researcher to conduct this research work. The study sought to explore the effectiveness of CONBJ4S on students' performance and retention of geometry in Katsina state.

Objectives of the Study

The following are objectives of the study were to:

1. Investigate the effect of Connectivism based jigsaw IV strategy on the students' attitude toward geometry; and
2. Examine the effect of Connectivism based jigsaw IV strategy on the students' performance in geometry.

Research Questions

The following questions were drowned to guide the study:

1. What is the difference between the mean attitude scores of the students taught geometry using the Connectivism based jigsaw IV strategy and their counterparts taught same concept using conventional lecture method?
2. What is the difference between the mean performance scores of the students taught geometry through Connectivism based jigsaw IV strategy and the other group taught same concept using conventional lecture method?

Research Hypotheses

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

- H₀₁:** There is no significant difference between the mean attitude scores of the students taught geometry using Connectivism based jigsaw IV strategy and their counterparts taught same concept using conventional lecture method.
- H₀₂:** There is no significant difference between the mean performance scores of the students taught geometry using the Connectivism based jigsaw IV strategy and their counterpart taught same concept using conventional lecture method.

Methodology

The research design used in this study was Quasi-experimental research design in order to establish a cause-and-effect relationship between the variables. The population of this study consist of 77,117 (i.e. $M = 44,113$ and $F = 33,004$) SS II public senior secondary schools' students in Katsina state. A sample of 221 students was selected from the two Zonal Education Quality Assurance out of twelve, using multistage sampling technique and used two intact classes as suggested by Aliyu (2016) that, quasi-experimental research design permits the use of intact class. One of the classes as experimental taught using CONBJ4S while the other as control group class taught through conventional lecture method. The instruments used for data collection of the study were Geometry Attitude Questionnaire (GAQ) and Geometry Performance Test (GPT) with the reliability coefficient of .79 and .85 respectively and validated by experts. The instruments were administered two

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times as pretest and posttest. All the research questions were answered using mean and standard deviation, while the hypotheses were tested using ANCOVA at .05 significance level.

Presentation of Results

Attitude towards geometry scores of the students' taught using CONBJ4S and CLM

To answer the research question one (1), GAQ marks of students taught geometry using CONBJ4S and those taught using CLM were subjected to descriptive statistics of mean and standard deviation in Table 1

Table 1

Mean and Standard Deviation Attitude Scores of CONBJ4S and CLM

Strategy	N	M	SD	MD
CONBJ4S	134	57.01	20.88	
CLM	87	52.38	11.13	4.63

Key: N = Total Number, M = Mean, SD = Std. Deviation, and MD = Mean Difference

Table 2 showed that the mean and standard deviation attitude scores of students taught mensuration using the CONBJ4S ($M = 57.01$, $SD = 20.88$) was higher than that of CLM ($M = 52.38$, $SD = 11.13$) with difference of 4.63 mean score. To investigate whether the difference is significant or not, null hypothesis one (1) was tested and the result presented in Table 2

Table 2

Analysis of Covariance Result on mean Attitude Scores of CONBJ4S and CLM

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	77925.185 ^a	2	38962.593	276.406	.000
Intercept	10283.197	1	10283.197	72.950	.000
Test	75681.440	1	75681.440	536.895	.000
Group	2291.640	1	2291.640	16.257	.000
Error	61459.175	436	140.961		
Total	1477057.000	439			
Corrected Total	139384.360	438			

Note. R Squared = .559 (Adjusted R Squared = .557)

Table 2 revealed that there was significant difference between the mean attitude scores of the students taught mensuration using CONBJ4S and the other group taught using CLM, $F(1, 436) = 16.26$, $p < .001$. Hence, the null hypothesis was rejected.

Performance scores of the students' taught using CONBJ4S and CLM

To answer the research question two (2), GPT marks of students taught geometry using CONBJ4 strategy and those taught using TRDM were subjected to descriptive statistics of mean and standard deviation in Table 3

Table 3

Mean and Standard Deviation Performance Scores of CONBJ4S and CLM

Strategy	N	M	SD	MD
CONBJ4S	134	41.83	20.35	
CLM	87	33.33	13.78	8.50

From Table 3 the mean and standard deviation performance scores of students taught geometry using the CONBJ4S ($M = 41.83$, $SD = 20.35$) was greater than that of those taught using CLM ($M = 33.33$, $SD = 13.78$) with difference of 8.50 mean score. To check whether the difference is significant or not, null hypothesis two (2) was tested and the result presented in Table 4.

Table 4

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	87299.056 ^a	2	43649.528	302.829	.000
Intercept	350.125	1	350.125	2.429	.120

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Test	79747.492	1	79747.492	553.267	.000
Group	7641.538	1	7641.538	53.015	.000
Error	62844.694	436	144.139		
Total	800813.000	439			
Corrected Total	150143.749	438			

Analysis of Covariance on Mean Performance Scores of CONBJ4S and CLM

Note. R Squared = .581 (Adjusted R Squared = .580)

Table 4 showed that there was significant difference in the mean performance scores of the students taught geometry using CONBJ4S and those taught through CLM, $F(1, 436) = 53.02, p < .001$. Hence, the null hypothesis was rejected.

Discussion of the Findings

The first finding from Tables 1 and 2 revealed that the students taught geometry using CONBJ4S recorded the highest mean attitude score compared to the other group treated using CLM with significant difference. It positively affected their attitude towards geometry and induced that, CONBJ4S offered them an opportunity to socialized and interacted with their team members which led them to more positive attitude towards the concept. This finding is in line with the finding of Tagle & Cabigan (2022) who noted that collaborative learning promotes the students' positive attitude to learning. Another corresponding finding include that of Suleiman et al (2020) in their study "Investigation into secondary school students' attitude towards learning of geometry in Zamfara State, Nigeria", which revealed that student's attitude towards geometry was significant and positively high. However, it was evident that students taught geometry using CONBJ4S developed more positive attitude towards geometry than those treated using CLM. Therefore, CONBJ4S helped students to improve their attitude towards geometry. In the second finding, Tables 3 and 4 showed that there was significant difference in the mean performance of students taught geometry using CONBJ4S in favor to those taught through CLM. This agreed with the findings of Waziri and Fasasi (2024) in their study on Effects of Jigsaw IV cooperative instructional strategy on academic performance in mathematics among post-basic schools' students in Adamawa State, Nigeria, and that of Jamilu et al (2022), which revealed that students taught using jigsaw IV strategy outperformed their counterpart taught using lecture method. It attributed to the fact that in connectivism based jigsaw IV strategy, students were actively involved in the learning process which agreed with the findings of Alzain (2019), which revealed that, the theory application has significance effect on students' performance. In the same way, Leow and Nao (2023) revealed that the students improved their collaborative skills and connectivism learning effectively enhanced the student learning process. According to Yussif (2022), one of the key features of Connectivism is that learners are actively involved in the learning process, they share information and ideas in their group to work as a team through cooperative work to create new knowledge for solved physical problems. Kilag et al (2023), added that connectivism-based instruction was the best approach to enhance students learning in the 21st century. Therefore, CONBJ4 strategy improves the students' performance in geometry.

Conclusion

The aim of this research work was to examine the effect of connectivism based jigsaw IV strategy in teaching and learning geometry among senior secondary students in Katsina state. Based on the study findings, it could be concluded that connectivism based jigsaw IV strategy was better and more effective in teaching geometry and could enhanced the students' performance and attitude towards geometrical concept more than the conventional lecture method commonly used in Katsina state. Since, the students were actively involved into the lesson activities of the strategy. Thus, the strategy could be used in place of conventional lecture method to yield better result.

Recommendations

On the basis of the findings and conclusion of the study, the following recommendations were made:

1. Secondary school mathematics teachers should be encouraged in using effective strategy in the classroom, especially CONBJ4S in teaching geometry and other related concepts.
2. CONJ4S should be added into curriculum for the teaching of Geometry in Senior Secondary Schools in Katsina state.
3. Professional bodies like Mathematics Association of Nigeria (MAN) and Science Teachers Association of Nigeria (STAN) should encourage the use of the strategy in all educational levels especially at junior and senior secondary schools.
4. Seminars, workshops and conferences should be organized for mathematics teachers on how to adopt CONBJ4S in teaching their students for the effectiveness and better achievement of the set objectives.



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