



Combined Effects of Thinkpair - Share and Blended Learning on Senior Secondary Schools Students' Performance in Geometry in Kogi State, Nigeria

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Abstract. This study investigated effects of Think Pair Share and Blended learning Strategies on Students' Academic Performances in Geometry in Senior Secondary Schools in Kogi State. Three research questions and three null hypotheses guided the study. The research adopted a pretest-posttest control group quasi-experimental design. The population comprised 12,703 SS II Mathematics students from public secondary schools, with a sample size of 344 (180 males and 164 females) students selected using a multi-stage sampling technique. One instrument Geometry Performance Test (GPT) was used for data collection. The instrument was face validated by three experts in Science Education Department (two experts from Mathematics Education Units/One expert from Measurement and Evaluation). In order to ensure the reliability of the instruments, 30 copies of GPT were trial tested on senior secondary school students that were not part of the sampled schools. The reliability of Geometry Performance Test (GPT) was determine using Kuder Richardson Formula 20 ($K-R_{20}$) and the reliability coefficient index 0.78 was obtained. The data collected was analyzed with respect to research questions and hypotheses. Mean and standard deviation was used in answering the research questions. For testing the null hypotheses formulated for the study, the analysis of covariance (ANCOVA) was used at 0.05 level of significance. The study found that the variation in students' academic performance in Geometry is significantly accounted for by the instructional strategies used. The results showed that both Think-Pair-Share and Blended Learning strategies significantly improved students' academic performance in Geometry compared to the conventional method. It was recommended that Parents should encourage their children to rely more on the scientific conception of the instructional strategies used in the geometry subject, thus

discouraging them from holding on to their wrong believe towards Geometry and Mathematics teachers should use Think-pair Share and blended learning in teaching geometry.

Keywords: Think pair share, blended, learning Geometry, performance,

1. Introduction

Mathematics is an important tool which human cannot do without. It provides opportunity to inculcate permanent literacy in an individual as well as laying a sound foundation for scientific and reflective thinking. It also helps tremendously in solving of problems in Health, Agriculture, Finance, Education, Religion, Transportation, Communication, Power and Housing sectors of any nation (Enyonam, 2022). Mathematical application is a very important, one need good knowledge of mathematics in having a good degree in the following areas; Chemistry, Physics, Engineering, Biology, Pharmacy (Sunday etal, 2014). One of the primary subjects emphasized in Nigerian schools and globally is Mathematics, given its crucial role in various academic disciplines, especially in Science and Technology (Akinsolu, 2014). Mathematics is fundamental in daily life, serving as a necessary skill for routine activities and interpersonal interactions. Proficiency in Mathematics is essential for the study of Sciences, Technology, and Humanities. The secondary school mathematics curriculum aims to foster the development of fundamental mathematical skills, covering areas such as arithmetic, algebra, geometry, and statistics. Alongside skill acquisition, the curriculum emphasizes the cultivation of problem-solving and critical-thinking abilities through the practical application of mathematical concepts (National Council of Teachers of Mathematics

(NCTM), 2020). Additionally, the curriculum strives to deepen students' understanding of mathematical ideas and their real-world relevance, encouraging connections between theoretical knowledge and practical applications. Integration of technology tools, such as graphing calculators and computer software, is a key objective to enhance mathematical comprehension (Organisation for Economic Co-operation and Development (OECD), 2019).

Teachers employ a range of strategies to fulfill the curriculum objectives. Active learning plays a crucial role, with educators engaging students in hands-on activities, group work, and discussions. Problem-solving tasks and real-life applications are incorporated to make mathematical concepts more tangible and applicable. Differentiated instruction allows teachers to cater to the diverse learning styles and abilities of students, providing additional support or challenges based on individual needs. Integration of technology, such as online resources and educational software, enhances interactive learning experiences (Federal Ministry of Education (Nigeria), 2014, Boaler, 2016). In today's technology-driven landscape, foundational mathematical knowledge is paramount for developing technological literacy and digital fluency, empowering individuals to navigate and contribute meaningfully in this increasingly interconnected world (Kress, 2014). Additionally, geometry learning promotes growth mindset, encouraging resilience and positive attitude toward learning, not only in geometry but also in other subjects and life endeavors (Boaler & Dweck, 2016). Recent research underscores the crucial role of teacher quality and the importance of diverse mathematical experiences and real-world applications in creating supportive classroom environments that foster students' engagement, collaboration, and individual growth (Kraft, *et al.*, 2018; Cai & Jiang, 2019). Students' effectiveness is inherently linked to the competence of their teachers. According to Suherman (2014) problem-solving ability include: (1) understand the problem, students can identify the elements that are known, where asked, and the adequacy of the required elements. (2) The settlement plan, construct a mathematical model, implement strategies to solve them. (3) Complete the planning and conclusions. With this think pair-share is one of the strategies to enhance positive increase in academic performance. Studies by Usman, *et al.*, (2017); Unamba, *et al.*, (2017); Ehiwario, *et al.*, (2021) revealed that new ideas and innovative instructional strategies that have proved effective in Mathematics are cooperative learning, problem-solving, Computer-Assisted Instruction (CAI) and Constructivism models, Blended learning and Think-Pair-Share (TPS).

Think-Pair-Share (TPS) is a cooperative learning strategy that offers significant benefits for secondary school students, particularly in enhancing their critical thinking and communication skills. Through the individual reflection phase ("think"), students engage in independent analysis of information, fostering critical thinking and problem-solving skills (Shadrina, 2014). Collaborative analysis in the "pair" phase allows students to compare approaches, identify inconsistencies, and refine their understanding through peer interaction, further strengthening critical thinking and communication abilities (Sejani, 2016). By articulating their reasoning and solutions during the "pair" and "share" phases, students develop strong communication skills, enabling them to express their ideas clearly and concisely (Liu & Hu, 2016). Active listening and respect for diverse viewpoints during discussions further enhance communication skills and create a more inclusive learning environment (Jumanta, 2014). Think-Pair-Share (TPS) strategy, created by Lyman (2016) and colleagues, is a cooperative learning approach involving three phases. Named after its sequential steps, TPS encourages individual and collaborative student engagement. It begins with individual contemplation on a topic, followed by the exchange of ideas with peers. Discussing with a partner enhances participation, focuses attention, and improves comprehension of reading materials. This cooperative strategy enhances the learning experience, affording students more time to ponder, react, and aid each other's understanding (Jumanta, 2014). As noted by Napitupulu and Surya (2017), think-pair share also encourages interaction and cooperation among students, potentially kindling an enhanced interest in Mathematics. Therefore, think – pair - share is very important for enhancing student's interest which in invariably may lead to high academic performance in the subject.

On the hand, blended learning, often referred to as hybrid learning, is an instructional approach that combines digital or online learning materials and activities with traditional face-to-face classroom methods. Blended learning, is a transformative educational approach that integrates traditional face-to-face instruction with the flexibility of online Bozkurt, *et al.*, (2015). This innovative blend has garnered significant research attention, consistently showing positive effects on student academic performance (Christenson, *et al.*, 2019). The approach holds great promise for enhancing learning in secondary schools, promoting critical thinking, and fostering problem-solving skills through active learning and collaboration (Means, *et al.*, 2014). Successful implementation necessitates careful

planning, design, and consideration of multiple factors. Key elements include well-defined learning objectives, structured online modules, and continuous support for both teachers and students. Moreover, access to technology, reliable internet connectivity, and appropriate learning software are indispensable components for the success of blended learning programs (Means & Murphy, 2014).

Wilson and Smilanich (2015) see blended learning as the implementation of the most effective learning solutions in a coordinated way to achieve the desired learning targets. Blended learning is a new type of education prepared for a group by combining the positive aspects of different learning approaches. Blended learning will provide a big convenience for the course to achieve its target by combining the face-to-face interaction in traditional learning and time, place and material richness provided by Web-based learning. Blended learning, a combination of online and face-to-face instruction, has become increasingly popular in recent times (Yang, 2016; Dziuban, *et al.*, 2018). This progressive method provides various advantages for students, educators, and institutions, positioning it as a crucial catalyst for personalized and efficient learning encounters.

The core of blended learning lies in its two components which include:

Online Learning: Leveraging technology, this component delivers interactive content, self-paced learning opportunities, and collaborative platforms (Dziuban, *et al.*, 2015; Park & Choi, 2019). Engaging video lectures, gamified learning activities, and adaptive learning technologies personalize the learning journey and cater to individual learning styles.

Face-to-Face Instruction: This component emphasizes social interaction personalized guidance, and deep learning through interactive discussions, hands-on activities, and individualized support (Yang, 2016; Hew & Cheung, 2015). Collaborative projects, Socratic dialogues, and formative assessments foster critical thinking, communication, and problem-solving skills.

Despite the curriculum's objectives and teaching approaches, both teachers and students encounter challenges. The abstract nature of certain mathematical concepts poses difficulties for students in grasping these ideas, prompting teachers to find effective ways to make abstract notions more concrete and relatable. Limited access to teaching resources, including textbooks and technology tools, poses a

challenge for educators (Adediwaju, 2015). Teachers must address diverse learning needs within a heterogeneous classroom, where students may vary widely in mathematical preparedness and learning styles.

Studies have revealed contradictory findings on the correlation between students' gender and their performance in Mathematics. While some studies indicated that there is no statistically significant difference in the students' performance in Mathematics based on gender (Olorunnishola & Sunday, 2024; Samuel & Sunday, 2024). Some studies revealed that males performed significantly better than their female counterparts in Mathematics (Nematullah, *et al.*, 2015; Amogne, 2015). While Ganley and Lubienski (2016) were of the view that these differences could be as a result of female students being a 'good girl' in school by doing strictly only the things the class teacher asks them to do. Hence, they do not try out other creative or risky things that could enhance their problem-solving skills in Mathematics which Think-pair share and blended learning instructional strategies might have helped.

Hence this study investigated the combined effects of think-pair share and blended learning instructional strategies on students' performance in Geometry at the senior secondary schools.

1.1 Statement of the Problem

In Nigeria, there has been a persistent issue of low student academic performance in mathematics, particularly evident in the Senior School Certificate Examination (SSCE) results reported by the West African Examination Council (WAEC) Chief examiner from 2011 to 2023 (WAEC, 2023). This consistent trend reflects challenges in grasping fundamental concepts such as Geometry among upper secondary school students in Nigeria. Researchers identify factors contributing to mathematics education issues, including lack of interest, inactive learning, ineffective instruction, and a shortage of qualified teachers. Notably, think pair share and blended learning strategies are highlighted for investigation. The present study investigated the effect of think pair share and blended learning strategies on students' academic performances in geometry, specifically in the Kogi State. The research addresses the gap in the existing literature regarding the impact of these instructional approaches in the study area. The question guiding the study is formulated as follows: what is effect of think pair share and blended learning strategies on students' academic performances in Geometry in Kogi state Nigeria?

1.2 Research Questions

The following research questions guided the study:

- What is the difference in the mean scores of students when taught geometry using combined think pair share strategy and blended learning strategies and those taught with conventional method?
- What is the difference of male and female students mean scores when taught geometry using think pair share and Blended Learning?
- What are the mean interaction effects of mode of instructional strategies and gender on academic performance scores of students in Geometry?

1.3 Research Hypotheses

The following hypotheses were stated and was tested at 0.05 level of significance.

H0₁: There is no significant difference in the mean scores of students in mathematics when exposed to geometry using think-pair-share and blended learning and those taught using conventional method.

H0₂: There is no significant difference in the mean scores of male and female students taught geometry using think pair share and blended learning strategies.

H0₃: There is no significant interaction effect of instructional strategies and gender on academic performance of students in geometry.

2. Literature Review

2.1 Theoretical Framework

This research was grounded on theories relevant to this study. For the course of this study, the following theory was used; Constructivist theory of learning and Collaborative learning theory.

2.2 Constructivist Theory of Learning

The main proponent of Constructivist learning theory was Jerome Bruner in 1966. The theory proposes the idea that learners construct knowledge and meanings for themselves individually and socially during learning process. Constructivism learning theory describes learning as an approach where teacher provides learners with an opportunity to construct their own sense and meaning in interpretation of what is being learned (Bruner, 1966). Constructivism theory also helps the teacher in designing and utilization of learning materials that engage. Stimulate and support meaningful learning of Mathematics. This creates

interest among students hence increasing enrolment and improve academic performance in Mathematics. Constructivist view the role of a teacher as that of a facilitator and a mediator where learning Constructivist theory of learning is a perspective in education that emphasizes the active role of learners in building their own understanding and knowledge of the world. This theory is based on the idea that learners actively construct meaning from their experiences, and learning is a process of assimilating new information into existing cognitive structures. The key principles of constructivism include the importance of prior knowledge, the role of social interaction, and the idea that learning is a dynamic, ongoing process.

In essence, the relevance of constructivism to the study of think pair share and Blended Learning in mathematics education extend beyond immediate academic outcomes. They encompass the cultivation of critical thinking skills, the promotion of self-directed learning, and the preparation of students for a lifelong journey of intellectual growth. By acknowledging the constructive nature of learning, educators can harness the potential of think pair share and Blended Learning to not only enhance interest and academic performances in mathematics but also instill a lasting passion for learning within the broader context of students' educational journeys.

2.3 Collaborative Learning Theory

The Collaborative Learning Theory is a process whereby a group (or groups) of individuals learn from each other by working together to solve a problem, complete a task, create a product, or share one's thinking. This theory is rooted in the work of Lev Vygotsky's (1934) social development theory and zone of proximal development, which highlighted the importance of communication and social interaction in learning. In 1972, Bruffee Kenneth introduced the learning method, Classroom Consensus Group, in which the teacher allocated students into groups and assigned them questions to answer or problems to solve together. This approach creates a community of learners, enhancing the collaborative aspect of the educational experience. Ultimately, the study explores how these collaborative strategies influence students' interest in mathematics and contribute to their academic performances, demonstrating the theory's application in the real-world context of secondary education. Think Pair Share, as a collaborative technique, embodies the theory by fostering interaction and shared knowledge construction. Through the process of individual thinking, paired discussion, and subsequent sharing with the entire class, students actively engage with one another,

contributing to a collaborative creation of understanding. Additionally, the integration of blended learning aligns with Collaborative Learning Theory by extending collaboration into the digital realm. The flexible and diverse nature of blended learning environments allows students to interact both online and in-person, accommodating different learning preferences. This approach creates a community of learners, enhancing the collaborative aspect of the educational experience. Ultimately, the study explores how these collaborative strategies influence students' interest in mathematics and contribute to their academic performances, demonstrating the theory's application in the real-world context of secondary education.

2.4 Empirical Studies

A study by Abiodun, *et al.*, (2022), examined the effect of the Think-Pair-Share strategy on student performance in secondary school science (Mathematics) in Ogun State Nigeria. Findings revealed that there is the main effect of the strategy on the student's performance in Geometry. Also, it was established that there is no significant effect of gender on the Geometry of the students in Mathematics. In another study by Akanmu, (2019), who examined the effects of think-pair-share on senior school students' performance in mathematics in Ilorin, Nigeria. Findings of the study showed: (i) a statistically significant difference in the performance of students taught set theory using think-pair-share compared with their counterparts in the control group in favour of think-pair-share group, (ii) no statistically significant difference in the performance of male and female students taught set theory in Mathematics using think-pair-share; (iii) no statistically significant difference in the performance of students taught set theory in Mathematics using think-pair-share based on scoring levels; and (iv) a statistically significant difference in the knowledge retained by students taught set theory in Mathematics using think-pair-share compared with their counterparts in the control group in favour of think-pair-share group. Another study by Mohammed and Sani, (2023), assess the Academic Performance and Interest in Algebraic Process using Think Pair Share Strategy among Secondary School Student's in Katsina Zonal Education Quality Assurance of Katsina state, Nigeria. The findings of the study led to the conclusion that, students taught algebra using Think-Pair-Share strategy performed significantly higher than their counterparts taught using lecture method. It was recommended that, the think Pair Share strategy should be incorporated into the teaching and learning of Mathematics at the Senior Secondary School level. The highlighted was similar to the current study

because both studies utilize the Think-Pair-Share strategy. The use only Think-Pair-Share strategy, while the current study was a combination of Think Pair Share and Blended learning instructional strategies. The highlighted was conducted in Katsina State while the current study was conducted in Kogi State, Nigeria

In a study by Indrapangastuti, *et al.*, (2021), aims to discover the effectiveness of the blended learning model in mathematics learning to improve the performance of mathematical concepts. The results of this study showed that the blended learning model is significantly more effective than the conventional learning model in enhancing students' performance of mathematical concepts. Another study by, Tong, *et al.*, (2022), Individuals attempting to study remotely during the COVID-19 lockdown will find that blended learning is a helpful solution and results in a significant increase in learning engagement. The best benefits for teachers and students are obtained by maximizing the advantages of each teaching method and by combining the advantages of online and face-to-face instruction. The study confirmed that blended learning positively impacts students' academic performance in the experimental class compared with the control class as demonstrated by the outcomes.

Another study carried out by Attard, and Holmes, (2020), investigated the effectiveness of the "flex model" of blended learning on students' academic performance, self-study skills, and learning attitudes in the context of teaching the mathematical subtopic of coordinates in the plane. Additionally, observations and student opinions indicated that blended learning increased student interaction with teachers and improved self-study abilities and learning attitudes. However, due to time constraints, not all students in the experiment showed significant progress. This study suggests that blended learning can be a valuable tool for enhancing mathematics learning outcomes, particularly for specific subtopics like coordinate systems, by providing flexible access to learning materials and fostering student engagement. The highlighted study uses only blended learning strategy, in contrast, the current study utilizes both Think Pair Share and Blended Learning Strategies. The highlighted study was conducted Vietnam, abroad. The current study is conducted in Kogi State, Nigeria.

Another study by Ekanem and Ikonne, (2019) examined the influence of gender on academic performance in Mathematics among senior secondary school students in Bayelsa State. Result of the analysis revealed that there is a significant difference in the

Mathematics performance of the male and female students in favour of the males. Hence this study investigated the effects of two instructional strategies while gender is a moderating variable.

3. Research Methodology

The research study employed a pretest-posttest control group quasi-experimental design to investigate the effect of two instructional strategies on academic performance and interest of students (Creswell, 2018). This design was chosen for its ability to assess the effectiveness of interventions by selecting groups with pre-existing characteristics (Achimugu *et al.*, 2024). The study consisted of two groups: experimental groups exposed to think pair share and Blended Learning and the Control group. Prior to the implementation of the instructional strategies, both groups were subjected to a pretest to measure their initial academic performance and interest levels. Subsequently, the designated instructional methods was applied, and posttests was administered to assess the changes. The comparison between the two groups provided valuable insights into the effectiveness of the instructional strategies, aiding in the evaluation of their effects on academic performance and interest levels. This quasi-experimental design offers a robust framework for discerning the relative merits of different teaching approaches in an educational setting.

The study was conducted in Kogi State. Kogi is a State in the North-Central Zone of Nigeria. The State shares common boundaries with Niger, Kwara, Nasarawa and the Federal Capital Territory to the North. To the East, the State is bounded by Benue and Enugu States, to the south by Enugu and Anambra States, and to the west by Ondo, Ekiti and Edo States (See Appendix B, page 112). In the State there are six education zones: Idah, Dekina, Ankpa, Lokoja, Okene and Kabba educational zones. The choice of Kogi State for the study arose because from literature available to the researcher, most of the research studies carried out on think pair share and blended learning strategies on students' interest and academic performance in geometry, were done outside State. The State consists three senatorial districts name; Kogi east, Kogi central and Kogi west (STETSCOM, 2024) (See Appendix C, page 113).

3.1 Population of the Study

The population of the study consists of 12703 (6,680 male and 6,023 female) senior secondary school two (SS II) Mathematics students from 254 public secondary schools in Kogi State, Nigeria. (Source:

Kogi State Science, technical Education and teaching service commission, 2024). The sample for this study comprised of 344 (180 males and 164 females) senior secondary two (SS II) mathematics students. A multi-stage sampling technique was employed in the sampling procedures. Firstly, purposive sampling technique was used to select fours (4) schools from each senatorial district. Give a total of 12 secondary schools that were co-education schools. These schools were suitable for the study because: The schools were co-educational to carter for gender variable. Second stage, simple random sampling technique by toss of coin was used to select two schools each from each of senatorial district bringing a total of 6 schools. Thirdly, simple random sampling technique by lucky dip was used in assigning two schools each to the two experimental groups and the control group. At the class level, no sampling was done because intact classes was used. Each of the schools had two streams and all were used, the way they were.

One instrument that was used for data collection is Geometry Performance Test (GPT) which are widely recognized instruments in the field of educational research for assessing students' interest in geometry and their performance in the subject, respectively. Geometry Performance Test (GPT) was adopted from WAEC past questions that are already validated.

Geometry Performance Test (GPT), elicited information on students' Academic Performance in Geometry. This contains 40 questions with four response options (A, B, C and D to each question. These were taken from the West African Examination Council (WAEC) past questions. The test was a kind of structured type. This was to allow the students to express their ideas freely and intelligently. Both experimental groups were taught using lesson plans. The lesson plan for teaching the experimental groups was written based on the method under study. There were eight lesson plan notes for each group and these were for the five topics, which were used to teach during the period of experiment to both groups. The students had not been taught these topics before the experimental period. They were selected from the term's scheme of work.

The Geometry Performance Test (GPT) was already a validated instrument as it was adopted from WAEC past questions.

Reliability of the Instrument: Geometry Performance Test was trial tested on senior secondary school students that were not part of the sampled schools. Raw scores of the respondents obtained from Geometry Performance Test (GPT) was determine

using Kuder Richardson Formula 20 ($K-R_{20}$) and the reliability coefficient index of 0.88 was obtained. Permission was sought from appropriate authorities of the sampled schools using introduction letter from the department science education to get approval in order to sample students under their domains for the purpose of this research. The regular mathematics teachers were used in administering the Instruments. The GIS was administered once and collected at the spot. The GPT pre-test was administered to the subjects two weeks before the experiment. Scores obtained by the students on the pre-test were recorded and kept aside for use after the experiment. At the end of the experiment, a post-test was also given to the class to ascertain the effect of treatment. A week training session was organized within the school by the researcher for the regular Mathematics teachers in the experimental group on the already validated topics. During the training session the researcher exposed the teachers to how to use think-pair share and Blended learning instructional strategies to teach Geometry for the teachers in the experimental groups while the control group were taught to using the conventional method. When the researcher made sure that the essential competencies had been acquired for the actual experimental treatment, the actual treatment was then conducted by the regular Mathematics teachers in both the experimental schools and control school. The lesson plans prepared by the researcher for each group were used by the teachers.

The teachers for the experimental groups used the think-pair share and Blended learning Instructional strategies while the teachers for the control group used the conventional method. The researcher monitored both groups at different periods to make sure that the teachers adhered strictly to the instruction in the lesson plan that was given to them. At the end of the experimental period, posttest was administered to the students. The data from both pre-test and posttest of both the experimental groups and control groups were collected and used for analysis. The Geometry Performance Test (GPT) was marked by the researcher. The scores obtained from the GPT was analyzed and used in answering the research questions and testing the hypotheses which guided the study.

3.2 Control of Some Extraneous Variables

The following procedures were adapted by the researcher to control some extraneous variables that might introduce bias into the study if they were not checked.

Novelty Effect

Novelty effect often occurs when students are working on a new material under a new teacher. The presence of a new teacher is likely to present a novelty effect on the students as a new teacher with a new method. To avoid this teacher bias, the students were taught by their regular Mathematics teachers who had taken part in the training session organized by the researcher. In view of this arrangement, the researcher was not involved in the administration of the experimental conditions.

Teacher Factor

No two individuals are exactly the same in skill and method. In order to control the errors that may surface due to differences among teachers, the researcher organized a uniform training programme for the teachers that were involved in the experiment. The objective of the training was to enable the teachers to acquire the competencies for carrying out the research conditions. The content of the training programme included a proper knowledge of the content/subject matter, performance objectives and students' activities with regard to the topics. The researcher was in close contact with the teachers during the period of experiment and discussion on the lesson plans and various students' activities with a view to ensuring that the teachers implemented what they learned from the training. By using the time tables of the school involved in the study, the researcher monitored the classes regularly to make sure that a uniform procedure of instruction was strictly adhered to by all the teachers concerned.

Test Effect

To control the continuous testing effect, the researcher administered the pre-test during mid-term test while the post test took place during the end of the term examination. In this way, students did not feel that they were taking part in any study.

Initial Group difference

As intact classes were used for the study, the control for nonequivalence of the classes was established by the use of the analysis of covariance (ANCOVA) to partial out the initial differences among the subjects.

3.3 Method of Data Analysis

Mean and standard deviation was used in answering the research questions. For testing the null hypotheses formulated for the study, the analysis of covariance (ANCOVA) was used at 0.05 level of significance. This is because ANCOVA is suitable in an experimental research design in order to control initial differences among the research subjects due to the use

of intact classes. The null hypotheses were rejected if the key P-value in each case is less than 0.05 but will not be rejected if otherwise.

4. Presentation of Results

Research Question 1: What is the difference in the mean score of students when taught Geometry using think pair share, blending learning strategy and those taught using conventional method?

Table 1: Pretest/Posttest Mean Scores of Students Taught Geometry using Think Pair Share and Blended Learning Strategy and those taught using Conventional Method

Method	Pre test		Posttest		Mean gain	
	N	\bar{X}	SD	\bar{X}		SD
Think-pair share	109	44.35	8.99	62.99	6.41	18.64
Blended Learning	115	38.81	8.76	58.47	8.01	19.66
Conventional Method	120	33.76	10.99	40.95	8.54	7.19

Result on Table 1 showed the pre-test and post-test mean academic performance scores of students taught Geometry using think pair share, blended learning strategy and conventional method. The result of the study showed that the students who were taught Geometry using Think-pair share instructional strategy had mean performance score of (\bar{X} = 44.35, SD = 8.99) at the pretest and mean performance score of (\bar{X} = 62.99, SD = 6.41) at the posttest, the mean gain score was 18.64. Also, the students taught the same topics using blended learning strategy had the mean performance score of (\bar{X} = 38.81, SD = 8.76) at pretest and mean performance score of (\bar{X} = 58.47, SD = 8.01) at posttest with a mean gain score of 19.66. Furthermore, the students taught Geometry using conventional method had a pretest mean performance score of (\bar{X} = 33.76, SD = 10.99) and posttest performance mean score of (\bar{X} = 40.95, SD = 8.54) with mean gain of 7.19. The higher mean gain scores of 18.64 and 19.66 for think-pair share and blended learning strategy groups respectively showed that think-pair share and blended learning instructional strategies improved students' academic performance more than conventional method with blended learning strategy proving more efficacious. Implying that think-pair share and blended learning strategies had positive effect on the mean academic performance scores of students in Geometry. This further implies that the treatment was effective. The closeness of SD varies in the three groups indicate that the respondents were homogenous in their responses to interest items.

Research Question 2: What is the difference of male and female students' mean scores when taught geometry using think pair share and blended learning?

Table 2: Pretest/Posttest of the Mean Scores of Male and Female Students Taught Geometry Using Think Pair Share and blended learning Strategies

Gender	N	Pretest		Posttest		Mean Gain	Mean Difference
		\bar{x}	SD	\bar{x}	SD		
Male	160	31.88	7.20	56.50	3.51	24.62	14.27
Female	184	42.83	10.40	53.18	9.53	10.35	

Result in Table 2 showed the influence of gender on the mean academic performance of students' taught geometry using think pair share strategies. Result showed that male students had pretest mean academic performance score of (\bar{x} =31.88, SD = 7.20) and a post-test mean academic performance score of (\bar{x} = 56.50, SD = 3.51), while the female students had a pretest mean academic performance score of (\bar{x} =42.83, SD = 10.83) and a posttest mean academic performance score (\bar{x} = 53.18, SD = 9.53). Result showed that the male students performed higher than their female counterparts with mean gain of 24.62 while the female students had mean gain of 10.35 resulting to a mean difference of 14.27 in favour of the male counterpart.

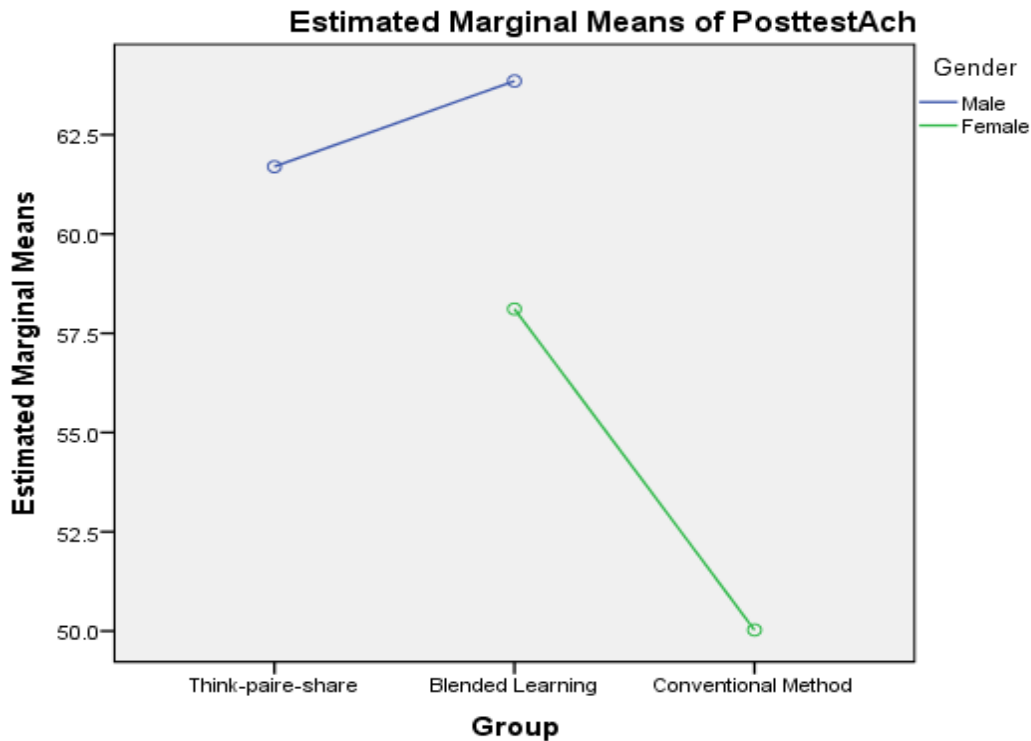
Research Question 3: What are the mean interaction effects of mode of instructional strategies and gender on academic performance of students in Geometry?

Table 3: Pretest/Posttest of the Mean Interaction Effects of Mode of Instructional Strategies and Gender on Academic Performance Scores of Students in Geometry

Instructional Strategies	Gender	N	Pre test		Posttest		Mean gain
			\bar{X}	SD	\bar{X}	SD	
Think-pair Share	Male	48	35.91	4.64	63.28	4.73	27.37
	Female	61	31.35	2.98	52.48	4.64	21.13
Blended Learning	Male	55	37.21	4.02	58.24	3.69	21.03
	Female	60	38.89	3.53	56.66	4.48	17.77
Conventional Method	Male	57	30.41	4.52	45.28	4.63	14.87
	Female	63	28.11	3.23	40.65	4.47	12.54

Result in Table 3 showed mean interaction effects of mode of instructional strategies and gender on academic performance scores of students in Geometry. Result showed that after the treatment, the male and female students taught Geometry using Think-pair share strategy had the academic performance mean gains of 27.37 and 21.13 respectively. The male and female students taught Geometry using Blended learning strategy had academic performance mean gains of 21.03 and 17.77 respectively, while the male and female students taught the same topics with conventional method had the academic performance mean gains of 14.87 and 12.24 respectively. These imply that male students showed greater academic performance with higher gain scores in all the three groups. To test for the significant interaction effect of instructional strategy and gender on students' mean academic performance scores in Geometry, see hypothesis eight. The Standard deviation presented in Table 8 above show that the interaction effect of teaching strategies among the three groups are relatively low judging from the amount of variation of values in their mean performance score and gender on students' academic performance in Geometry taught in this study. This is because of the homogeneity of items response among the male and female students in Geometry. This result is further explained using an interaction graph in Figure 2 which showed that there was no significant interaction effects of instructional strategies and gender on students' mean academic performance scores in Geometry. This is evidenced in the graph as the lines representing instructional strategies and gender did not intercept at a point as shown in the graph below

Fig. 1: Graph showing the interaction effect of instructional strategies and gender on students' interest.



Covariates appearing in the model are evaluated at the following values: PretestAch = 42.29

Non-estimable means are not plotted

Ho₂: There is no significant difference in the mean academic performance scores of students in geometry when exposed to geometry using think-pair-share, blended learning and conventional instructional strategies.

Table 4: Analysis of Covariance (ANCOVA) of Difference in the Mean Academic Performance Scores of Students in Geometry When Exposed to Think-Pair-Share, Blended Learning and Conventional Instructional Strategies

Source	Type III Squares	Sum of Df	Mean Square	F	Sig.	Partial Eta Squared	Decision
Corrected Model	17477.982 ^a	2	8738.991	259.463	.000	.603	
Intercept	20962.280	1	20962.280	622.377	.000	.646	
PretestPerf	10659.228	1	10659.228	316.476	.000	.481	S
Methods	6981.622	1	6981.622	207.287	.000	.378	S
Error	11485.227	341	33.681				
Total	1157590.000	344					
Corrected Total	28963.209	343					

Note: S = Significant, NS = Not Significant and η^2_p = partial eta squared

The result in Table 4 showed the ANCOVA of the difference in the mean academic performance scores of students in geometry when exposed to think-pair-share strategy, blended learning instructional strategy and conventional method. The result was statistically significant at (F) = 207.287, p = 0.00, η^2_p = 0.378). Since the associated probability value of 0.00 is less than 0.05 set as level of significance, the null hypothesis was rejected. Thus, inference drawn is that there was a statistically significant difference in the mean academic performance scores of students in geometry when exposed to think-pair-share strategy, blended learning instructional strategy and conventional method in favour of the treatment groups with high mean. The result further showed the effect size (η^2_p = 0.38), which indicates that thirty eight percent (38%) variance in the mean academic performance scores of students in geometry when exposed to think-pair-share can be explained by blended learning instructional strategy.

Ho₄: There is no significant difference in the mean scores of male and female students taught geometry using think pair share and blended learning strategies.

Table 5: Analysis of Covariance (ANCOVA) of the Difference between the Mean Scores of Male and Female Students Taught Geometry Using Think Pair Share and blended learning Strategies

Source	Type III Squares	Sum of Df	Mean Square	F	Sig.	Partial Squared	EtaDec.
Corrected Model	18182.685 ^a	3	6060.895	191.151	.000	.628	
Intercept	20434.684	1	20434.684	644.476	.000	.655	
Pretest Perf	11279.393	1	11279.393	355.734	.000	.511	
Methods	.421	1	.421	.013	.908	.000	
Gender	704.703	1	704.703	22.225	.000	.061	S
Methods*Gender	.000	0	.000	.530	.690	.150	NS
Error	10780.524	340	31.707				
Total	1157590.000	344					
Corrected Total	28963.209	343					

Note: S = Significant, NS = Not Significant and η^2_p = partial eta squared

The result in Table 5 showed the ANCOVA of the difference between the mean academic performance of male and female students taught geometry using think pair share strategy. The result was statistically significant at (F) = 22.23, p = 0.000, η^2_p = 0.061). Since the associated probability value of 0.000 is less than 0.05 set as level of significance, the null hypothesis was rejected. Thus, inference drawn is that there was a statistically significant difference between the mean academic performance of male and female students taught geometry using think pair share strategy in favour of the male with higher mean scores. The result

further showed the effect size (η^2_p = 0.061), which indicates that sixty-one percent (61%) variance in the mean academic performance of male and female students taught Geometry using think pair share can be explained by other factors.

5. Summary of the Findings

From the analysis of data and interpretation of results, the following findings emerged:

The finding of the study showed that there was a statistically significant difference in the mean academic performance scores of students in geometry when exposed to think-pair-share strategy, blended learning instructional strategy and conventional method in favour of think-pair-share strategy and blended learning instructional strategy that had higher means. The findings further showed with the aid of post-hoc analysis that think-pair is better compare to blended learning strategy.

The finding of the study showed that there was a statistically significant difference between the mean academic performance of male and female students taught geometry using think pair share strategy in favour of male that had higher mean ratings.

The finding of the study showed that there was no statistically significant interaction effect of instructional strategies and gender on academic performance of students in Geometry.

6. Discussion of Results

The result showed that students who were taught geometry using think pair share strategy had higher mean academic performance score than the group taught blended learning strategy. This implied that, think pair share strategy had a significant effect on geometry students than the blended learning strategy. The finding of the study is also supported by the test of hypothesis two which found that, there was a statistically significant difference in the mean academic performance of students in geometry when exposed to think-pair-share and blended learning instructional strategies. This implied that thirty eight percent (38%) variance in the mean the academic performance scores of students in geometry when exposed to think-pair-share and blended learning strategic can be explained by conventional instructional method. Think-Pair-Share (TPS) and blended learning strategies have several features that contribute to their superiority over conventional teaching methods. One of the key advantages of TPS is its promotion of active engagement. In TPS, students first think individually about a problem, then discuss their thoughts with a partner, and finally share their conclusions with the class. This structured approach ensures that all students are actively involved in the learning process, which fosters deeper understanding and retention of the material. The collaborative nature of TPS also enhances social interaction and communication skills, as students learn to articulate their ideas and listen to others' perspectives.

Blended learning, on the other hand, offers unparalleled flexibility and personalization in education. By combining online educational materials with traditional face-to-face instruction, blended learning allows students to access content at their own pace and according to their personal learning styles. This approach accommodates diverse learners and can be particularly beneficial for students who need more time to grasp complex concepts. Additionally, the use of multimedia and interactive content in blended learning keeps students engaged and makes learning more dynamic. The integration of technology also enables immediate feedback through online assessments, helping students to quickly identify and address their mistakes.

Both TPS and blended learning also excel in developing higher-order thinking skills and providing a supportive learning environment. TPS encourages critical thinking and problem-solving as students analyze and discuss various solutions with their peers. This peer-to-peer interaction not only reinforces their understanding but also builds confidence, as students feel more comfortable sharing ideas in smaller groups before presenting to the entire class. Blended learning, with its mix of online and offline activities, offers opportunities for personalized feedback and continuous assessment, allowing teachers to tailor instruction to meet the specific needs of each student. In contrast, conventional methods often rely on passive learning and a one-size-fits-all approach, which can limit student engagement and the development of essential skills. This finding agrees with Indrapangastuti *et al.*, (2021) who investigated on the effectiveness of the blended learning model in geometry learning to improve the performance of mathematical concepts and found that blended learning model is significantly more effective than the conventional learning model in enhancing students' performance of mathematical concepts. This means that the application of blended learning in geometry learning can significantly improve students' performance of mathematical concepts. The finding is in consistent with Tong *et al.*, (2022) who found a significant difference on students' academic performance in the experimental class compared with the control class. The finding of the study is not in agreement Mukuka, *et al.*, (2021) who found that students had mixed experiences with remote blended learning on academic performance in geometry. This finding agreed with Abiodun, *et al.*, (2022) who investigated the effect of think pair share on students' academic performance in mathematics and found out that there was a main significant effect of the strategy on mathematics than the conventional method. This means that the application of think pair share in

geometry learning can significantly improve students' academic performance. This finding is in consistent with Akanmu (2019) who examined the effect of think pair on senior school students' performance in mathematics and found that there was a statistically significant difference in the performance of student taught set theory using think pair share strategy compared to their counterpart in the control group in favour of think pair share strategy group. This study also supported Mohammed and Sani (2023) who examined academic performance and interest in algebraic process using think pair share strategy among secondary school students and found out that the students taught algebra using think pair share strategy performed significantly higher than their counterpart in conventional method. The above showed that think-pair share improved student's academic performance when taught using think-pair share strategy

Result showed that male students performed higher in academic performance than their female counterparts' geometry. The finding of the study is also supported by the test of hypothesis four which found that, there was no statistically significant difference between the mean academic performance of male and female students taught geometry using think pair share and blended learning strategy in favour of male counterparts. This implied that fifteen percent (15%) variance in the mean academic performance of male and female students taught geometry using think pair share can be explained by blended learning instructional strategy. The finding of the study is in disagreement with Oribhabor (2020) who examined the influence of gender on academic performance in Geometry among senior secondary school students in Bayelsa State and found a significant difference in the Mathematics performance of the male and female students in favour of the males when taught with think-pair share strategy. The finding is also disagreed with Adeyemo *et al.*, (2021) who investigated on the effect of student gender on interest and their performance in mathematics and found a significant effect between male and female students' interest and their performance in mathematics when they are exposed to blended learning strategy. The finding of the study was in agreement with Allahnana, and Usman (2018) who investigated on the relationship between gender, interest in mathematics, and mathematics performance among secondary school students in Keffi Local Government Area of Nasarawa State, Nigeria and found no significant difference between male and female academic performance in mathematics.

The result showed that male students' interaction effect mean academic performance is higher than their

female counterparts in geometry. The finding of the study is also supported by the test of hypothesis eight which found that, there was no statistically significant interaction effect of instructional strategies and gender on students' academic performance in geometry. The finding agrees Abiodun *et al.*, (2022) who researched and found that there is no significant main effect of gender on the performance of the students in Mathematics. The finding agrees with Guiso *et al.*, (2020) who researched on gender differences in the interest and academic performance in mathematics schoolwork across 50 Countries and found no gender interaction in mathematics performance. The finding was in disagreement with Ekanem and Ikonne, (2019) who examined the influence of gender on academic performance in Mathematics among senior secondary school students in Bayelsa State and found that interaction effect of gender on students' academic performance in mathematics. Hence, gender has a substantial influence on students' academic performance in mathematics.

7. Conclusion

The finding of the study showed that there was a statistically significant difference in the mean interest ratings of students in geometry when exposed to think-pair-share strategy, blended learning instructional strategy and conventional method in favour of think-pair-share and blended learning strategies with think pair share strategies having significant lead after post hoc analysis. The finding of the study also, showed that there was a statistically significant difference in the mean academic performance scores of students in geometry when exposed to think-pair-share strategy, blended learning instructional strategy and conventional method in favour of two experimental groups with think-pair share strategy having significant lead based on the post-hoc analysis. The finding of the study showed that there was a statistically significant difference between the mean interest ratings of male and female students taught geometry using think pair share strategy in favour of the male counterpart. The finding of the study showed that there was no statistically significant difference between the mean academic performance of male and female students taught geometry using think pair share strategy. The finding of the study showed that there was no statistically significant interaction effect of instructional strategies and gender on students' interest ratings in geometry. Furthermore, the finding of the study showed that there was no statistically significant interaction effect of instructional strategies and gender on academic performance of students in geometry.

8. Recommendations

The following recommendations were made according to the findings of the study:

Parents should encourage their children to rely more on the scientific conception of the instructional strategies used in the geometry subject, thus discouraging them from holding on to their wrong beliefs towards Geometry.

Geometry teachers should ensure that the various terminologies in the subject are sufficiently explained to students with scientific justifications in order to dissuade students from relying on their wrong beliefs towards Geometry.

Parents and teachers should help correct the wrong notions held by male and female students about Geometry subject.

Curriculum planners should include scientific justifications against the various instructional strategies used in teaching and learning of geometry.

Government through the federal and state ministries of education should provide the required instructional materials to enhance both male and female students' understanding of the various terminologies in Geometry.

It is also recommended that both think-pair share and blended learning strategy should be used in teaching geometry since it improved students' academic performance in geometry.

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