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Developing Students' Creativity and Promoting Achievement by Using Peer-Tutoring as a Strategy for Teaching School Geometry in Taraba State, Nigeria

Musa Mohammed Balasa
Department of Mathematics, College of Education, Zing, Taraba State, Nigeria
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Abstract

Research is replete with evidence indicating that classroom practices in the state of Taraba particularly and in Nigeria generally are predominantly teacher-centred. Teacher-centred classroom activities have evidently been shown to be largely responsible for students' under-achievement in school geometry in Taraba state. In this approach, students learn geometry in passive situations instead of being active. On the other hand, the teacher, viewed as the major actor, employs and emphasizes routine arithmetic which encourages geometry students to not only repeat activities but also memorize materials. The consequence of this is that students merely become able to carry out straight-forward calculations or computations and less able to understand geometrical/mathematical ideas. The result is that they achieve poorly in the subject (geometry). On the other hand, research evidence clearly indicates that when learners are made to be the focus of geometry instruction, they are made to think and to participate actively in the teaching/learning process. Active participation leads to greater achievement in geometry. This investigation is to explore the use of peer-tutoring as a teaching strategy for making students learn geometry actively and to develop abilities for critical thinking and being creative. To achieve this, students were made to work in small groups as peers to actively think and make sense of given properties of geometric figures like rectangles, triangles, trapezia, and so on. The study employed the use of quasi-experimental design for its conduct. A sample of 176 Senior Secondary Two (SS2) students (88 males and 88 females) was randomly taken and used, using cluster random sampling. Six (6) research questions guided the conduct of the study and three (3) null hypotheses were formulated for testing at the 0.05 level of significance. Two instruments were used to get information i.e., Properties of Geometric Figures Test (PGFT) and Geometry Performance Test (GPT). To analyze data, mean, standard deviation and t-test were used. Based on findings, recommendations were made.

Keywords: Developing, Peer-tutoring, Instructional Strategy, Creativity, School Geometry.

Introduction

A country having numerous creative people has great potential for economic growth. When quite a good number of young, able-bodied citizens of a country are creative, the country has powerful assets for significant economic growth. The world in which we are living today is increasingly becoming a world of creativity. It therefore becomes progressively necessary for well-meaning Nigerians to not only embark on talent search in young Nigerian Senior Secondary School students but also strive to develop these talents into creativity. The current researcher got his inspiration from this desire to study creativity.

Can a teacher's classroom practice be used to promote creativity?

Research reports are available showing that most, if not all geometry teachers in the state of Taraba handle geometry teaching by using positivist teacher-centered approaches. In these approaches, learners are made to learn geometry passively by mostly listening to the geometry teacher with hardly any contribution made by them to the teaching/learning process. The major actor, the teacher, dominates the whole process and emphasizes routine arithmetic which characteristically requires the learners to memorize materials and repeat activities. Consequently, the geometry students are only able to develop the ability to use straight-forward computing procedures, thus having a limited understanding of mathematical or geometrical ideas (Balasa, 2021). Ultimately, achievement becomes poor in the subject. On the other hand, research has it that when students are the central focus of instructions, opportunities are abundantly created not only for them to think but also to take active part in the teaching/learning process. That is to say that student-centeredness as an approach to instruction creates opportunities for geometry learners to exhaustively navigate all the learning process through active participation and critical thinking. So, learning becomes meaningful and achievement becomes enriched. This inspired the current researcher to investigate peer-tutoring as a student-centred approach to instruction.

Undoubtedly, peer-tutoring is an accredited student-centred approach to instruction. How does it happen? An able student teaches another student or other students who are peers, with the whole process being guided and supervised by the geometry teacher in the classroom. It is obvious from this situation that Peer-tutoring is student-centered since students teach and learn themselves. Any geometry teacher wishing to bring improvements to student learning is advised to employ student-engaging and participatory or collaborative methods arranged to include activities that provoke critical thinking and opportunities for working together to solve geometric problems. Such opportunities exist in peer-tutoring, an instructional strategy, which establishes a kind of partnership between high-achieving students and others who work collaboratively together during geometry classroom sessions. Other strong points of peer-tutoring as reported by research include:

- Retention of learnt material is promoted;
- Students' self-esteem is raised
- Rates of students' responses and feedback are increased;
- Opportunities for students to practice specific skills are created;
- By teaching geometry to peer students, the student tutor's understanding of the subject becomes greater;
- Social interactions are encouraged;
- Geometry students are encouraged to develop positive attitudes to geometry learning;
- The strategy helps students to develop self-confidence; and
- Students' achievements are improved.

These ingredients and others not mentioned here prompted the current researcher to investigate the potentials peer-tutoring has for developing creativity in geometry students in the state of Taraba.

A nation striving to develop economically must make advances in science and technology. A nation whose citizens are mathematically literate will have developments in science and technology facilitated. Balasa (2023), quoted in Wilson (2005) observed that Mathematics (or geometry in particular), does not only facilitate the intellectual development of an individual, it is also the foundation upon which the much needed scientific and technological development of the individual's country stands. Mathematics is an effective tool for developing the capacities of individuals for clear logical thinking with a view to finding scientific solutions to problems. As a subject area which is based on logic and pure reasoning, geometry is an aspect of mathematics attracting lots of critical and logical thinking. This informs the current researcher’s bid to investigate peer-tutoring as a strategy for teaching school geometry to help develop and maintain critical thinking in our Senior Secondary students.

Geometry is taught and learnt to primarily develop in students’ capability to accomplish a wide variety of complex geometrical tasks. Geometers and mathematicians have traced

the role of task-accomplishment and reported its rich history. Many literate people in geometry consider the study of geometry to be the same with doing the following:
Solving word problems;

- Creating patterns;
- Discerning situations;
- Interpreting figures; and
- Proving and using theorems.

All these are critical elements of creativity. As a matter of facts, learning to solve problems is the principal reason for the study of geometry (mathematics) (U.S. National Council of Supervisors of Mathematics, 2008). The current investigator was motivated by this fact to start the study of task-accomplishment in geometry.

In Nigeria, geometry teaching and learning play a significant part in the study of mathematics. A close look at the national mathematics curriculum discloses that geometry enjoys a significantly high presence in this curriculum. Evaluation wise, examining bodies such as WAEC, NECO, NABTEB, etc. set examination questions for mathematics from a considerably large area of geometry. For example, 35%, 38%, 40%, 42% and 37% of the multiple choice items (fondly called objective questions), set by the West African Examinations council (WAEC), for 2012, 2013, 2014, 2015 and 2016 respectively, were all drawn from geometry. Again, in an annual report for the year 2015, WAEC chief examiner included geometry among subject areas in which candidates were weak. The frequent setting of questions by WAEC from geometry and the board's declaration of geometry as a difficult subject in which students are generally weak, inspired the current researcher to focus investigation on geometry.

Achievement means succeeding in doing something or reaching a goal (De Jager-Haum, 2000). It can therefore be said that achievement is a measure of success in doing something. Educationally, achievements are measured by the test scores testees make on a test. Accordingly, the geometry achievement of participating students in this study was measured by their test scores on the PGFT and the GPT. The study investigated peer-tutoring as a strategy for developing critical thinking in Senior Secondary students in the state of Taraba and for enriching their achievement in geometry.

Purpose (Objective) of the Study

Generally, the purpose or objective of this investigation was to determine the impact of peer-tutoring instructional strategy on students' creativity and achievement in geometry. Specifically, the objective of the study was to determine the impact of:

1. Peer-tutoring instructional strategy on creative thinking of geometry students;
2. Peer-tutoring method of teaching on students' achievement in geometry;
3. Peer-tutoring teaching method on male students' achievement in geometry;
4. Peer-tutoring method on female students' achievement in geometry;

5. To determine whether the mean achievement scores of students in the experimental class (peer-tutoring class) was different from that of students in the control (lecture) class.

Research Questions

The following research questions guided the conduct of the investigation:

1. What is the mean score of peer-tutoring students (students in the experimental classroom)?
2. What is the mean score of control students (students in the lecture classroom)?
3. What is the mean score of male peer-tutoring students (male students in the experimental classroom)?
4. What is the mean score of female peer-tutoring students (female students in the experimental classroom)?
5. What amount of critical thinking was observed in the peer-tutoring classroom?
6. What amount of critical thinking was observed in the lecture classroom?

Research Hypotheses

The following three (3) null hypotheses were formulated and tested at the 5% (0.05) level of significance:

H_0: There is no significant impact of peer-tutoring strategy of instruction on students' achievement in geometry.

H_{02}. There is no significant difference between male students' achievement and that of their female counterparts in the Peer-tutoring classroom

H_{03}. Peer-tutoring instructional strategy has no significant impact on students' creative thinking in learning school geometry.

Method

A quasi-experimental design was used to study the impact of Peer-tutoring instructional technique on geometry students' critical thinking (creativity) and achievement in the subject (geometry). Participating students worked in two different classrooms, one experimental and another control. The experimental participants, also called treatment, were treated to Peer-tutoring activities. These participants worked in small groups of size 4 (2 males and 2 females) with one of them adjudged to be a high achiever who taught geometry to the rest or others. The control participants on the other hand simply listened to lectures delivered to the whole class by the geometry teacher. For the conduct of this investigation, the researcher randomly sampled one hundred and seventy six (176) senior Secondary Two (SS2) students. There were two phases of sampling. In phase 1, 4 out of the 118 Senior Secondary Schools in the state of Taraba were randomly chosen for the study. Cluster random sampling method was used for this choice. That is to say that the researcher divided all public Schools across Taraba state into four clusters with a cluster containing schools in four local government areas. The researcher then chose a school from each of these clusters by random balloting. The chosen schools were labeled Schools 1, 2, 3 and 4. To select students who participated in the study, the researcher used simple random technique to choose two intact classes from each of the 4 randomly chosen schools. All students in the 8 randomly chosen intact classes participated in the study. At the end of phase 1 of sampling, the following table emerged showing distribution of participants according to chosen schools:

Table 1: Distribution of Participants According to Schools:

Schools	**1**		**2**		**3**		**4**		
Classes	A	B	C	D	E	F	G	H	Total
Males	20	19	19	20	17	16	17	19	147
Females	14	14	13	13	14	12	13	15	108
Total	**34**	**33**	**32**	**33**	**31**	**28**	**30**	**34**	**255**

Source: Field Study, (2025)

Phase 2 of Sampling involved the proportionate assignment of 22 participants to each of the classrooms labeled A, B, C, D, E, F, G and H, (11 males and 11 females). Table 2 below gives the distribution of these participants;

Table 2: Distribution of Actual Participants in the Study

Schools	**1**		**2**		**3**		**4**		
Classes	A	B	C	D	E	F	G	H	Total
Males	11	11	11	11	11	11	11	11	88
Females	11	11	11	11	11	11	11	11	88
Total	**22**	**22**	**22**	**22**	**22**	**22**	**22**	**22**	**176**

Source: Field Study, (2025)

From the distribution above (table 2), two Sub-samples are seen i.e. a male sub-sample having 88 male participants and a female sub-sample having 88 female participants as well. In all, the two Sub-samples add together to 176 participating students, the total for the major sample. Two instruments were used to get information for analysis and interpretation. They were Properties of Geometric Figures Test (PGFT) and Geometry Performance Test (GPT). The PGFT was a hands-on activity test which involved manipulation of geometric items.

This test was used by the researcher because of his belief in the suggestion made by Van Hiele (1999) that giving learners ample opportunity for playful, active exploration of hands-on manipulatives provides teachers with a chance to observe and assess informally, learners’ understanding of and thinking about the geometric concepts being tested. Items on the PGFT were based on concept cards bearing the shapes of triangles and quadrilaterals (the so-called manipulatives). These items were designed such that testees were required to do tasks involving identifying, naming, classifying, defining and writing down properties of shapes. Opportunities Created by these manipulative activities gave the researcher a very good chance of observing and assessing learners' thinking behaviors because of Kilpatrick's opinion that, "We learn by doing and by thinking about what we do". The GPT on the other hand was an instrument that tested participants' ability to use learnt properties of plane shapes to solve geometric problems. The two instruments were proclaimed valid by 5 seasoned mathematics teachers in 5 different public schools and a great mathematics educator in Modibbo Adama University (MAU), Yola after validating. Test-retest reliability method was used to determine the reliability of the two tests. Pearson's Product Moments Correlation Coefficient (PPMC) method was used to estimate the reliability coefficients of the PGFT and GPT as 0.87 and 0.82 respectively.

Experimental Procedure

In order to have information from which to declare results and draw conclusions, the researcher gave instructions to participants in two (2) distinct settings, an experimental setting and a control setting. In the experimental setting, a class of 88 participants (44 males and 44 females) were subjected to instructions in a constructivist atmosphere, the teaching method basically being peer-tutoring. Because of the nature of its treatment, this classroom was called "experimental". In the control setting, another class of 88 participants too (44 males and 44 females) were subjected to instructions in a traditional teaching atmosphere, the teaching method basically being lecture to the whole class. Because of its nature, the classroom was called 'control'. To be able to effectively carry out the experimental activities, experimental teachers were treated to a training session during which they received special grooming to be able to:

i. Meticulously guide students work in small groups of 4 (2 boys and 2 girls) with one of the four accredited as a high achiever to teach the others. Students were guided to work freely and collectively as members of their groups to do explorative work in geometry. The researcher remained a guide and a facilitator.
ii. Adopt Yager's (2001) constructivist learning model (CLM) as teaching approach for guiding the students carry out the experimental activities. Experimental teachers did the following:
    - ✓ Recognized and built on learners' Pre-existing knowledge;
    - ✓ created interactive learning environment;
    - ✓ Encouraged learners to challenge, contest and negotiate meaning(s);
    - ✓ Promoted collaborative work among learners.

- ✓ Used open-ended questions to encourage learners to elaborate on their responses.
- ✓ Encouraged learners to seek their own solution paths or strategies; and
- ✓ Encouraged learners to reflect on and refine their ideas.

To be able to conduct the control activities, the control teacher was groomed to simply give instruction in the conventional whole class setting (lecture). For the most part, the participants passively listened to the teacher's talks. After sessions of instruction in the two classrooms (experimental and control), the following tests were administered:

a) Properties of Geometric Figures Test (PGFT) – to obtain information on learners' ability to identify, name, classify, define, and describe properties of geometric figures; and
b) Geometry Performance Test (GPT) – to get information on students' ability to use properties of shapes to solve geometrical problems.

The SPSS software was used to analyze data generated from the administration of the PGFT and the GPT. The mean and standard deviation scores were used to answer the research questions raised while the t-test statistic was used to test the null hypotheses at the 5% (0.05) significance level.

Results

Research results (findings) are presented and analyzed in this section of the report. For ease of presentations, tables are used. Preceding each table, two research questions are asked and items presented in the table serve as answers to these questions. Following each table and the analysis of its content is a statement of null hypothesis for testing at the 5% (0.05) level of significance. The statistic employed for this hypothesis testing is the t-test. A statement is made after the summary of results to either accept or reject the stated null hypothesis.

Research Questions 1 and 2

1. What is the mean score of treatment students (peer-tutoring geometry students)?
2. What is the mean score of lecture students (lecture geometry students)?

The mean and standard deviation scores of treatment students (students in the peer-tutoring classroom) and control students (students in the lecture classroom) are presented in table 3 below:

Table 3: Mean and Standard Deviation Scores for Treatment and Control Students

Student Groups	N	Mean	Standard Deviation
Treatment	88	8.09	6.53
Control	88	7.20	5.95
Difference		0.89	0.58

Source: Field Work, 2025

Clearly, table 3 (above) shows that the experimental or treatment students (geometry students in the peer tutoring classroom) recorded 8.09 as their mean and the control students (students in the lecture classroom) recorded a mean score of 7.20. A difference in mean of 0.89 is noticed. Further, treatment students recorded 6.53 as standard deviation score while control students were reported to have recorded 5.95, giving a rise to a difference in mean standard deviation score of 0.58. The noted differences in mean and standard deviation (0.89 and 0.58) respectively are obviously showing the superiority of the achievement of treatment students over that of their control counterparts.

Ho_1: There is no significant impact of peer-tutoring strategy of instruction on students' achievement in geometry.

Table 4 below presents the summary of the t-test analysis of SS2 students' geometry achievement on the Geometry Performance Test (GPT):

Table 4: Summary of t-test Analysis of SS2 Students' Achievement on the GPT:

Student Groups	**N**	**Mean**	**Std. Dev.**	**t-cal**	**t-crit**	**Df**	**Inference**
Treatment	88	7.51	5.01	14.5	1.96	174	Significant
Control	88	5.8	2.62				

Source: Fieldwork, 2025

Looking at table 4 (above), figures indicate that students in the learner-centred classroom who learnt actively had greater mean achievement score (7.51) than that of their control counterpart in the teacher-centred classroom who learnt passively. Again, the calculated value of t (14.5) was clearly larger than the value of the critical t (1.96). So, the hypothesis of no significant impact was rejected, indicating that there is significant impact of peer-tutoring strategy of teaching on students' achievement in geometry.

Research Questions 3 and 4

3. What is the mean score of male peer-tutoring students (male students in the experimental classroom)?
4. What is the mean score of female peer-tutoring students (female students in the experimental classroom)?

Table 5 (below) bears the mean and standard deviation scores of male and female students in the peer-tutoring or experimental classroom:

Table 5: Mean and Standard Deviation Scores of Male and Female Peer-tutoring Students

Sex	N	Mean	Standard Deviation
Male	44	6.46	5.40
Female	44	5.09	4.2
Difference		1.37	1.2

Source: Fieldwork, 2025.

From table 5 (above), male treatment students have a mean score of 6.46 while female treatment students have a mean score of 5.09 (with a difference in mean of 1.37). Further, male treatment students have a standard deviation score of 5.4 while female treatment students have a standard deviation score of 4.2, giving a difference in standard deviation score of 1.2. These differences in mean and standard deviation scores are indications of the superiority of male students to that of females.

H_{02}: There is no significant difference between male students' achievement and that of their female counterparts in the peer-tutoring classroom.
The summary of the t-test analysis of SS2 male and female peer-tutoring students' achievement on GPT is presented in table Six (6) below:

Table 6: Summary of t-test Analysis of SS2 Male and Female Treatment Students' Achievement on the GPT:

Sex	N	Mean	Std. Dev.	T-cal	t-crit.	Df	Inference
Male	44	9.5	6.01	15.01	1.96	86	Significant
Female	44	6.9	4.23				

Source: Fieldwork, 2025.

Evidently, there is an indication in table Six that male students in the peer-tutoring classroom had a mean score of 9.5 on the GPT. Their female counterparts, on the other hand, had a mean score of 6.9, indicating that the male mean score was significantly higher than the female mean score. Further, the calculated value of t (15.01) exceeded the critical value of t (1.96), meaning that the null hypothesis was rejected. Conclusively, male peer-tutoring students' achievement on the GPT was significantly different from that of their female counterparts.

Research Question 5:

5. What amount of critical thinking was observed in the peer-tutoring classroom?

To answer research question 5, the researcher did the following qualitative works:

- ✓ Qualitatively observed the behaviours of learner-participants as they worked in small groups (4 in a group) to accomplish geometrical tasks;
- ✓ Listened to and noted learners' utterances as they collectively discuss their work;
- ✓ Asked learners questions about the tasks (where necessary) and received responses, noting whether the responses were intelligent or not; or whether they emanated from critical thinking.

At the end of the exercise, the following observations emerged:

i. Learners collaborated by working together in small groups to solve geometrical problems by using concept cards having geometrical shapes on, including their properties;

ii. Their collaborative work got strengthened each time they asked questions about geometric shapes and their properties, sought clarifications from one another and reasoned collectively to get answers to the questions;

iii. Most of the questions asked were logical and appeared to have emanated from reasonably deep thoughts;

iv. Learners interestingly questioned one another's arguments and ideas, revised positions and took decisions based on emerging evidence;

v. Sometimes, learners moderated early decision(s) and refined their ideas when new, convincing evidence(s) or reason(s) emerged;

vi. Students' arguments appeared to have been generated by reasonably deep, critical thinking about properties of geometrical shapes.

vii. The atmosphere in which the peer-tutoring students worked was observed to be very friendly where students appeared to have greater freedom than working elsewhere (such as with their teacher or some more senior person) – freedom to ask, freedom to respond, freedom to argue or criticise, etc;

viii. Each small group of participants was led by a peer-tutor who played double roles, academic and leadership;

ix. Sometimes student interactions became so rowdy that the instructor/researcher had to bring participants to order;

x. The geometrical shapes accomplished by participants were based on properties of geometrical shapes which promoted reasoning due to their logical nature and were learnt in interactive situations, and

xi. A lot of critical thinking (creativity) was observed to have occurred in this peer-tutoring classroom.

Research Question 6:

6. What amount of critical thinking was observed in the lecture classroom?

In like manner, the researcher sought answer(s) to research question 6 in a similar way as in research question 5. Qualitatively, the researcher observed the behaviours of participating students who solved geometrical problems by listening to lectures in a whole class setting. The following were the researcher's observations:

i. For most part of the instruction, participating students listened to talks about geometrical shapes and their properties, given by the teacher (researcher), with hardly any contribution made by the students;
ii. Participants only shortly saw concept cards shown to them by the teacher at demonstration time without giving them opportunities to handle and use them to describe their properties, shapes and argue about their properties;
iii. Participants had small opportunities for asking questions about shapes and their properties, the only few questions asked were simple and were of shallow-level thinking;
iv. There were few evaluation questions from the teacher, so participants had small opportunities for responding.
v. No opportunities were observed in which participants think critically about shapes and their properties, argue with reason(s) and finally bring new evidence, revise initial position(s), and take decision(s); and
vi. Very small or no critical thinking/creativity was observed in this lecture (control) classroom.

Summary of Findings

The following points summarize the findings of this study:

1. Participating students who worked in the peer-tutoring classroom called the experimental or treatment class where a variety of interactive situations were created, and where students worked in small groups and with geometrical concept cards and models, supervised and guided by the teacher, had their mean and standard deviation scores significantly higher than those of their control counterparts who learnt their geometry in the lecture classroom in a whole class setting in the atmosphere of passivity;
2. Gender was a learning factor because male treatment students had better achievement than female treatment students as indicated by their mean and standard deviation scores on the Geometry Performance Test (GPT);
3. Participants learnt in social situations by working in small groups with lots of collaboration to actively accomplish geometrical tasks;
4. Due to the collaborative nature of their work, the following scientific acts were observed:

- Questioning to seek to understand a geometric problem,
- Thinking critically about questions to find responses,
- Responding to questions,
- Revising earlier position(s) with new reason/evidence,
- Moderating decision(s), and
- Observing, arguing, basing arguments on reasons, and reporting

5. Activities in the peer-tutoring classroom created opportunities for critical thinking that had potentials for making learners become creative,
6. Participants learnt not only academic skills but also leadership skills in productive situations;
7. Atmospheres for working freely and friendly were observed;
8. Unfortunately, instructions in the Peer-tutoring classroom were rowdy;
9. In the lecture classroom, passivity with small or no contribution from learners to the teaching/learning process was observed;
10. Control students hardly asked questions and if they did at all, the questions appeared to have been generated by low-level thoughts;
11. Only very few opportunities were created for control students to answer questions and majority of the few questions were answered incorrectly;
12. Hardly any critical thinking was observed in the control classroom;
13. It was affirmed (confirmed) that peer-tutoring strategy of instruction had significant impact on students' achievement in geometry and creativity; and
14. Similarly, it was confirmed that a significant difference exists between male and female treatment students' achievement in geometry.

Discussion

As a general finding of this study, it can be stated that in the teaching and learning of school geometry, three variables are of paramount importance and that one can have impact on another. These variables are critical thinking, a promoter of creativity, teaching technique and achievement. Clearly, teaching technique had impacted achievement as was clearly shown by the researcher's statement of finding. The researcher's statement of finding reads, "Participating students who worked in the peer-tutoring classroom called the experimental or treatment class where a variety of interactive situations were created, and where students worked in small groups, and with geometrical concept cards and models, supervised and guided by the teacher, students' mean and standard deviation scores were significantly higher than those of their control counterparts who learnt their geometry in the lecture classroom in a whole class setting in the atmosphere of passivity. Treatment students' Scores of higher mean and standard deviation marks were clearly caused by the adoption of a teaching strategy called peer-tutoring. The dynamics of this strategy were that students worked in small groups, interacted with peers who taught themselves, and with concept cards and models, and collaboratively learnt geometry. These situations created and maintained a better environment, atmosphere, and opportunities for geometry learning than was the case in the conventional, passive lecture classroom.

Balasa (2022) reported a similar finding in a research work titled “the effect of misconceptions in learning school geometry on students’ achievement in geometry.” In this report, Balasa (2022) indicated that achievement-wise, treatment students had superior scores to those of control students, as evidenced by differences between their mean and standard deviation scores. The report further indicated that in the classroom with better achievement, instructions were exemplary, involving the use of various instructional materials by skillful and well-experienced geometry teachers. Instructions in the control group, on the other hand, were delivered through the normal lecture with students mostly passively learning. Impliedly, better learning opportunities were created in the treatment classroom than they were in the control class. Achievement was therefore accordingly higher in the treatment class than it was in the control class. This situation is a replica of the current researcher’s finding. It goes very well to confirm that if students are to learn school geometry meaningfully, then the right atmosphere for it to occur must be created.

Gender was found by the current study to be a learning factor because male treatment students had better achievement than female treatment students, as indicated by their mean and standard deviation scores in the Geometry Performance Test (GPT). This finding was similar to that of Balasa (2024). Balasa’s finding reads, “Another discovery made by this investigation was that male students in the experimental group achieved higher mean and standard deviation scores than female students in the same group (experimental). Similarly, male students in the control classroom were superior in achievement than their female counterparts in the same classroom due to observed differences in mean and standard deviation scores.” This means the sex of students in the study was a variable that helped in determining the measure of achievement made by these students in geometry, just as is the case with the current study. Thing and Kwan Eu (2015) and Attebe and Schafer (2010) made a similar discovery.

Another discovery made by current investigation concerned collective work in which the researcher said that participants learnt in social situations by working in small groups with lots of collaboration to actively accomplish geometrical tasks. Due to the collaborative nature of their work, the following scientific acts were observed:

- Questioning to seek to understand a geometric problem;
- Thinking critically about questions to find responses;
- Responding to questions;
- Revising earlier position(s) with new reason (evidence);
- Moderating decision(s); and

- Observing, arguing, basing arguments on reasons, and reporting.

These scientific acts are reportedly capable of promoting emotional intelligence, reasoning ability, memory capacity and intelligence. Looking at the literature, previous researchers have reported similar findings.

Musa, Dangana, Usman and Mari (2021) made a similar discovery and reported that a moderately positive significant relationship exists between emotional intelligence and academic achievement, a highly positive relationship between memory capacity and academic achievement, a highly positive relationship between reasoning ability and academic achievement and a highly positive relationship between intelligence and academic achievement. Numerous other researchers have reported same discoveries. To exemplify Rozell, et al. (2002); David, et al. (2005); and Singh, et al. (2009), reported a significant relationship between emotional intelligence and the GPA (grade point averages) students made in their courses. More explicitly stated, the reports indicated that students having high emotional intelligence had higher GPA's than students having low emotional intelligence. But another researcher, Johnson (2008), had a disagreeing finding with his report indicating no significant correlation between emotional intelligence and the GPA's of students. In further showing similarity between current and previous findings, Ertepman (1995); Cavallo (1996); Abisamra (2000); Oloyode (2012); and Mari (2012) reported reasoning ability being a predictor of student achievement in biology. This report was in sharp disagreement with the reports of Kuchon (2012) and Caren, et al. (2016) in which they stated that reasoning ability was not a predictor of students' achievement in biology.

With respect to memory capacity, Alloway, et al (2004); Bull (2008); Huada, et al (2009); and Swanson (2016) reported that students with high memory capacity had significantly better performance than students with low memory capacity. However, Ershova, et al (2016) had a different finding in which no significant correlation was found between memory capacity and student achievement. Archana (2002); Martin (2004); Laidra, et al (2007); and Deshparde (2014) reported a strong reliance of academic achievement on cognitive abilities. Matching this was a study report by Habibollah, et al. (2010); and Riggo, et al. (2013) which indicated no significant correlation between students' intelligence and academic achievement. This study also made another great discovery concerning creativity with the report indicating that students in the peer-tutoring classroom developed tendencies for critical thinking that had the potential for making them creative. Such beautiful tendencies were not observed in the lecture classroom. Clearly, the researcher spotted participants behaving much in the same way as Goldstein (2015) reported as being the behaviors of creative persons. To these researchers, creativity is nothing other than an individual's ability to process new ideas and techniques through critical thinking and imagination. The participants were also able to explore intensively and were open to experience. This discovery was similar to that of Frith, et al. (2021) in which the researchers reported that an individual's creativity depends on his/her ability to explore extensively and to remain open to experience. The current investigation equally found a significant impact of the peer-tutoring strategy of instruction on students' achievement in geometry.

This agreed with Balasa's (2021) finding of the existence of a significant difference between treatment students' achievement and that of control. The same finding was similarly reported by Atebe and Schafer (2010), Siting Usiskin. Also majorly confirmed by this (current) study was the existence of a statistically significant difference between males and females' geometry achievement in the treatment (peer-tutoring) classroom. Clearly, this is an indication that gender is a factor in determining students' achievement in geometry. Atebe and Schafer (2010) and Tieng and Kwan Eu (2015) reported similar findings.

Recommendations

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

1. For geometry to be effectively taught and learnt, geometry teachers are encouraged to employ teaching strategies that create opportunities for students to learn in social situations, suggestingly Peer-tutoring, a strategy in which peers interact with other peers, and with teachers and materials to learn more meaningfully and achieve more greatly.
2. Geometry teachers are advised to be mindful of gender while they prepare and deliver lessons in geometry since gender has been found to be a learning factor by this study.
3. Teachers are to prepare and deliver instructions such that collaboration is not only involved but is also promoted as students have been found to enjoy doing geometrical tasks in cooperative manner.
4. Geometry teachers are called upon to always choose peer-tutoring (p-t) as a strategy for instruction in their teaching. This is because P-t can create environments and opportunities for children to develop their creative talents into creativity so they become more relevant to live in the twenty-first-century creative world.
5. It is recommended strongly for geometry teachers to use Peer-tutoring in their classrooms because it creates for more free and more friendly atmospheres for children to work and learn.

Conclusion

The current investigation concluded that:

1. Participating students who worked in the peer-tutoring classroom called the experimental or treatment class where a variety of interactive situations were

created, and where students worked in small groups and with geometrical concept cards and models, supervised and guided by the teacher, had their mean and standard deviation scores significantly higher than those of their control counterparts who learnt their geometry in the lecture classroom in a whole class setting in the atmosphere of passivity.

2. Gender was a learning factor because male treatment students had better achievement than female treatment students as indicated by their mean and standard deviation scores on the Geometry Performance Test (GPT).
3. Participants learnt in social situations by working in small groups in which lots of collaboration to actively accomplish geometrical tasks.
4. Due to the collaborative nature of their work, the following scientific acts were observed:
   - Questioning to seek to understand a geometric problem;
   - Thinking critically about questions to find responses,
   - Responding to questions asked,
   - Revising earlier positions with new reason/evidence,
   - moderating decision(s), and
   - Observing, arguing, basing arguments on reasons, and reporting.
5. Activities in the peer-tutoring classroom created opportunities for critical thinking that had potentials for making learners become creative.
6. Participants learnt not only academic skills but also leadership skills in productive situations.
7. Atmospheres for working freely and friendly were promoted.
8. Unfortunately, instructions in the peer-tutoring classroom were rowdy.
9. In the lecture classroom, passivity with small or no contribution from learners to the teaching/learning process were observed.
10. Control students hardly asked questions and if they did at all, the questions appeared to have been generated by low-level thought.
11. Only very few opportunities were created for control students to answer questions and majority of the few questions were answered incorrectly.
12. Hardly any critical thinking was observed in the control classroom.
13. It was confirmed that peer-tutoring strategy of instruction had significant impact on students' achievement in geometry and creativity.
14. Similarly, it was confirmed that a significant difference exists between male and female treatment students' achievement in geometry.

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