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COLLABORATIVE PROBLEM-SOLVING STRATEGY AND SENIOR SECONDARY SCHOOL STUDENTS' PERFORMANCE IN BEARING IN BOSSO LOCAL GOVERNMENT AREA, NIGER STATE NIGERIA

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Abstract
The study examined collaborative problem-solving strategy and senior secondary school students' performance in bearing in Bosso local government area of Niger State. A quasi-experimental design was employed for the study. The population of the study consisted of 4,478 SS Two students from 17 public senior secondary schools. Two intact classes were randomly selected from two schools using simple random techniques. A total of 215 SSII students formed the sample. The experimental group has a sample size of 105 (63 males, 42 females) and the control group has a sample size of 110 (77 males, 33 females). Two research questions and null hypotheses were formulated and tested at 0.05 levels of significance. An instrument was developed for data collection (used for pre-test and post-test) and validated by experts, with a reliability coefficient estimated as r = 0.73. The results revealed that there was a significant difference in the performance of students taught bearings using collaborative problem-solving strategy (CPS) and those taught using Conventional Teaching Method (CTM). Also, there was no significant difference in the performance of male and female students taught bearing using CPS. Based on the findings, it was recommended among others that mathematics teachers should incorporate CPS in their instructional strategies.

Keywords: Collaborative, Problem-solving, Performance, Bearing, Mathematics

Introduction

In Nigeria's educational system, mathematics is one of the intellectual disciplines taught at all levels. Six major ideas in mathematics were taught in senior secondary schools in Nigeria: number and numeration, algebra, geometry, trigonometry, statistics, and probability. A branch of mathematics called trigonometry is concerned with the study of bearings and distances. In terms of degrees from north, bearings are the clockwise angular relationships between two distant locations (Adu, 1998). The four cardinal directions—North, South, East, and West—are the relevant directions. Without an understanding of bearings ideas, science and technology are frequently limited to the surface level, especially in the sciences, engineering, and surveying. Even though mathematics is important and relevant to senior secondary students, academic performance has been poor (Gimba, 2013; Gambari et al., 2014). According to research findings, students' performance in secondary school internal and external examinations has generally been subpar, particularly in trigonometrical concepts (Ahmad & Zakariyya, 2021). Bearings in the contemporary secondary school curriculum are acknowledged as difficult in the teaching and understanding of trigonometry. Learning about bearings is thought to be challenging, abstract, and tough by students, who as a result develop a negative attitude and do poorly in the SSCE examination. Inadequacy of learning aids, large class sizes, inadequately qualified teachers, and the usage of traditional teaching methods are some of the factors responsible for poor performance in trigonometry, especially bearings (Khadija, 2018). WAEC (2019) observed that various trigonometry concepts, particularly bearings, have received complaints from students who found them difficult to understand and teachers who found them difficult to teach.

The conventional Teaching Method (CTM) is a classic talk-on-a-chalkboard teaching approach in which the teacher speaks most of the time while the students listen and take notes. The strategy allows for thorough coverage of the curriculum while saving time and being less laborious. The method, according to mathematics instructors, is teacher-centred with little to no student participation since students are viewed as listeners. Because it simply appeals to the ears, the traditional method of teaching does not encourage real mathematics learning. Most

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frequently, it has been observed that CTM has favoured gifted and high-ability students and placed low-ability students at disadvantage. The approach either piques students' interests or discourages critical and creative thinking in them (Ahmad & Zakariyya, 2021). Consequently, for these reasons, the researchers adopted collaborative problem-solving in this study.

In the Collaborative Problem-solving (CPS) approach, a class is divided into groups of two or three students to learn together with a common objective in one class session or even fewer, depending on the nature of the work done by each group. Before partnerships are created and engaged, the teacher introduces the problem topic, gives the essential background knowledge, teaches, and uses the appropriate resources to facilitate the learning. As a result, each group member interacts with the others in their group to solve the mathematical problem that has been given to them, and the teacher walks from group to group, asking questions to monitor and improve each group's activity. The instructor ensures that students are engaged and actively participating in the given task. In their studies on collaborative problem-solving strategies, Thomas (2004) and Halpin et al. (2017) discovered that students using this technique are actively participating in meaningful group discussions as they gradually master mathematical concepts. Because the strategy promotes practical labour rather than the less in-depth, more readily recalled, and forgotten "teach-it-to-them or tell-it-to-them method". Furthermore, the learning materials are retained better over time. The experts hold that while students might actively create their mathematical knowledge, it cannot be imparted. Engaging students in problem-solving and social contact are features of this technique, which is one way to build mathematical knowledge. The groupings are diverse, including students with various educational backgrounds, different ways of thinking, and various interests.

Gurtner et al. (2016) found that mathematics students who were taught using a collaborative problem-solving strategy performed better than those who were taught using a standard approach. As inductive reasoning is a cognitive process that is essential to mathematics, this approach can be used to teach students to do so when considering rules, facts, and concepts. On the other hand, the approach motivates students to help each other in a small group work toward a common objective. The plan included procedures that enhance improved performance and retention in any given activity, including relationship management, communication skills, the sharing of ideas, jointly identifying the issue, and negotiated agreements (Halpin et al., 2017). Numerous studies have linked gender difficulties to students' academic achievement, but none of them has come to a firm conclusion. According to certain studies, male students outperformed female pupils in science (Nsofor & Nasiru, 2013). Similar research demonstrated that boys outperformed girls in mathematics (Gambari et al., 2014). But according to Mary and Moses (2013) and Gimba (2013), female students outperformed male students in mathematics. Ngozi (2013) also found that the typical method of instruction does not work for female students who desire to pursue careers in the sciences and mathematics. In light of this, the researchers looked into how senior secondary school students in the Bosso Local Government Area's academic performance concerning collaborative problem-solving strategy.

Statement of the Problem

According to reports, several variables, including bad teaching practices that place excessive reliance on memory and broad coverage of the mathematics curriculum, are to be blamed for the continuous failure in perceived difficult concepts of mathematics, particularly bearings and distances (Khadija, 2018). According to a recent assessment by the chief examiner of the West African Examination Council (WAEC, 2019), female students consistently performed much worse on trigonometry questions. Therefore, the purpose of this study is to ascertain how collaborative problem-solving strategy affects senior secondary school students' academic performance when it comes to understanding trigonometric principles in mathematics.

Aim and Objectives of the study

The study aimed to determine the effect of collaborative problem-solving strategy on senior secondary school students' performance in bearing in Bosso Local Government Area. Specifically, the objectives of the study are to:

1. determine the performance of students taught bearing concepts using collaborative problem-solving strategy and those taught using conventional teaching method.
2. Determine gender differences in academic performance of students taught bearing of concepts using collaborative problem-solving strategy.

Research Questions

To guide this study, the following research questions were asked:

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1. What are the academic performance scores of students' taught bearing concepts using collaborative problem-solving strategy and those taught using conventional teaching method?
2. Will there be any gender difference in the academic performance of students taught bearing concepts using the collaborative problem-solving strategy?

Null Hypotheses

The following null hypotheses were formulated and tested at a 0.05 level of significan
ce

Ho1: There is no significant difference in the academic performance of students taught bearing concepts using collaborative problem-solving strategy and those taught using conventional teaching method.

Ho_2: There is no significant difference in academic performance of male and female students taught bearing concepts using collaborative problem-solving strategy.

Materials and Methods

Research Design: The quasi-experimental design was adopted.

Participants: All 4,478 public secondary school students in the Bosso Local Government Area, Niger State, made up the study's population. The public schools are chosen since their admission and promotion policies, teachers' qualifications, and learning resources are similar. The students were between the ages of 18 and 25. Two intact classes were randomly selected from two schools using simple random techniques. A total of 215 SSII students formed the sample. The experimental group has a sample size of 105 (63 males, 42 females) and the control group has a sample size of 110 (77 males, 33 females).

Instrumentation: Three instruments were developed by the researchers; these are the Bearing Performance Test (BPT), a lesson model based on a collaborative problem-solving strategy, and a lesson plan based on the conventional teaching method. The Bearing Performance Test (BPT), is a test consisting of forty multiple-choice questions covering bearings and distances. The instrument's reliability coefficient was determined using Pearson Product Moment Correlation (PPMC) of the test re-test at r = 0.73, and the instrument's validity was achieved through submission to three independent assessors who are experts and hold the rank of senior lecturers in the department of science education of FUT, Minna, and Ibrahim Badamasi Babangida University, Lapai. BPT was employed for the pre-test and its randomized form was used for the post-test.

Method of data collection:

i. Task introduction: The teacher presents the problem topic, provides relevant background knowledge, and explains the task while using all essential teaching aids.

ii. As groups are formed, each group is given a specific assignment to do.

iii. Collaborative work: Each group meets to discuss problems and find solutions. The teacher switches from one group to the next, checking their understanding of the stages and keeping an eye on their development.

iv. Evaluation at the conclusion: the teacher calls the group representative to present a solution proposal and the teacher guides them to have a meaningful discussion. While the control group was taught using the conventional teaching method.

Results

A pre-test called the Bearing Performance Test (BPT) was utilized to compare the academic standing of the two groups. The t-test was used to analyze the pre-test data. Table 2 displays the investigation's findings.

Table 2: t-test Analysis of pre-test for Experimental and Control Groups

Group	N	Mean	SD	df	t-cal	p-value	Remark
Experimental	105	46.70	16.32	213	-0.60	.55	Not sig
Control	110	47.93	16.35				

Table 2 displays the independent sample t-statistic results of both experimental and control groups. According to table 2, there was no discernible difference between the two groups' mean performance scores for the students (T=0.60, df=213, p=.55). This suggests that before the treatment, the two groups were academically equivalent.

Research Question 1: What are the academic performance scores of students taught bearing concepts using collaborative problem-solving strategy and those taught using conventional teaching method? Table 3 shows the results of research question one using descriptive analysis.

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Table 3: Descriptive Analysis of Control and Experimental Groups in Post-test

Group	N	Mean	SD	Mean Difference
Experimental	105	62.42	13.95	12.96
Control	110	49.46	14.74	

Table 3 recorded the mean performance score of the experimental group as 62.42 and mean score of the control group was 49.46, the mean gain score was 12.95 in favour of the experimental group.

Null hypothesis one: There is no significant difference in the academic performance of students taught bearing concepts using collaborative problem-solving strategy and those taught using conventional teaching method. An independent sample t-test statistic was employed to evaluate this hypothesis, and table 4 displays the outcome.

Table 4: t-test Analysis of Control and Experimental Groups in Post test

Group	N	Mean	SD	df	t-cal	p-value	Remark
Experimental	105	62.42	13.75	213	6.71	0.00	sig
Control	110	49.46	14.74				

The result in Table 4 indicated that p-value was 0.00 which was less than alpha=0.05. This confirmed that there was a significant difference in the mean performance scores of students taught using collaborative problem-solving strategy and students taught using conventional teaching method. The null hypothesis was therefore rejected.

Research Question 2: Will there be any gender difference in the academic performance of students taught bearing concepts using collaborative problem-solving strategy?

The results presented in Table 5 provide the solution to research question 2 of the study.

Table 5: Descriptive Analysis of Male and Female Students in Post-test

Group	N	Mean	SD	Mean Difference
Male	63	52.74	14.44	2.74
Female	42	50.00	16.17	

Table 5 shows the mean performance of male students as 52.74, while the female students have 50.00. The mean gain was in favor of male students.

Null Hypothesis Two: There is no significant difference in the academic performance of male and female students taught bearing concepts using collaborative problem-solving strategy. To test the hypothesis the data collected were subjected to an independent sample t-test statistic and the result was presented in Table 6.

Table 6: t-test Analysis of Male and Female Students of the Experimental Group in Post-test

Group	N	Mean	SD	df	t-cal	p-value	Remark
Male	63	52.74	14.44	103	1.43	0.15	Not sig
Female	42	50.00	16.17				

From the result in Table 6, the p-value recorded (0.15) was greater than 0.05 which was an indication that there was no significant difference in the academic performance of male and female students taught bearing using collaborative problem-solving strategy, it can be concluded that the null hypothesis was retained.

Discussion

According to Table 4 findings, students in the experimental group who received instruction using CPS outperformed their counterparts in the control group who received instruction using CTM in terms of academic performance. This conclusion is corroborated by Thomas (2004) and Halpin et al. (2017), who discovered that the teacher's strategies had a beneficial impact on students' achievement performance because they were actively

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engaged in the teaching and learning process. This outcome is attained as a result of the strategy's encouragement of group collaboration to share ideas and work toward a common instructional objective. Another benefit of collaborative problem-solving is that it may be utilized to help students develop inductive reasoning—a cognitive process essential to mathematics—about concepts and rules.

Table 6 revealed that there is no significant difference between male and female students who were taught bearing via CPS in terms of academic success. This suggests that CPS is gender inclusive. Mari & Moses (2013) and Gimba (2013) reported in their respective studies that female students do much better than male students in the sciences and mathematics, which is contrary to this finding.

Conclusion

It was discovered that students taught using CPS outperforms students taught using CMT in terms of academic achievement when the two learning methodologies (CPS & CTM) were compared in mathematics, particularly trigonometry (bearings and distances) topics. Therefore, using a collaborative problem-solving strategy to solve problems improves academic success. Additionally, group problem-solving benefits the equality of learning in mathematics for both male and female students.

Recommendations

The following recommendations were made based on the findings of this study:

1. It is advised that mathematics teachers employ CPS as an educational technique at the senior secondary school level. CPS has been demonstrated to be a successful technique for improving students' academic performance in light of (mathematics).
2. Regardless of gender differences, all senior secondary school students should be given an equal opportunity to participate in the teaching and learning process in the classroom.
3. Conferences, seminars, and in-service training should expose mathematics teachers to CPS.
4. To improve performance, students should be made aware of the critical roles that social interaction plays in class discussions. Working together makes it easier to comprehend the work and develop peer trust.

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