
EFFECT OF DIFFERENTIATED INSTRUCTION ON THE ACADEMIC PERFORMANCE OF SENIOR SECONDARY SCHOOL STUDENTS IN MATHEMATICS IN RIVERS STATE, NIGERIA

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Abstract

This study investigated differentiated instruction and senior secondary school students' academic performance in mathematics. The study was guided by two research questions and two corresponding null hypotheses. The research design used was quasi experimental which involved the use of pretest, posttest and intact classes. The study presented one experimental and one control group. The experimental group was taught mathematics with differentiated instruction while the control group was taught with traditional teaching method. The mathematics contents that were taught were matrices and determinants. The population of the study comprised of all the senior secondary two (SS2) students in Port Harcourt Local Government Area of Rivers State, Nigeria. Purposive sampling technique was used to select a sample of one hundred and twelve senior secondary two (SS2) students from the population of the study. The title of the instrument that was used to collect data was "Mathematics Performance Test" (MPT). The instrument was made up of fifty multiple-choice test items with four options. The face and content validity of the instrument was done by three experts in mathematics education. Test retest method was used to establish an internal consistency of 0.82 for the instrument, MPT. The students in the two groups were administered the instrument. After which the experimental group was taught with differentiated instruction while the control group was taught with direct instruction. The two groups were thereafter administered with posttest. The research questions were answered using mean and standard deviation while the null hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 significant level. The result showed that there was a significant difference between the performance of students that were taught mathematics with differentiated instruction and those that were taught with traditional teaching method. The result also showed that there was no significant difference between the male and female students that were taught mathematics with differentiated instruction. It was concluded that differentiated instruction improved the academic performance of students in mathematics than the use of traditional

teaching method. It was recommended that teachers should use differentiated instruction to teach students mathematics

Keywords: Mathematics, Differentiated Instruction, Performance, Gender, students

Introduction

Mathematics is an academic subject which occupies an important place in the primary and secondary school. Its application is seen in everyday activities of an individual's potentiality and the entire nation (George, 2023). It is the key to other science subjects and vocational endeavor. Olaleye and Aliyu (2021) posited that mathematics is the backbone of all scientific and technological investigations and all activities of human development. Mathematics is a discipline which seeks and uses patterns to formulate new conjectures. This implies that mathematics has the potential to resolve the truth or falsify phenomena using mathematical proof. The subject matter of Mathematics deals with parameters such as counting, measurement, estimation, calculation, shapes and logic.

Mathematics has rendered its usefulness in the everyday activities of man. Its usefulness also extends to both organizational and societal development. Every human needs a certain level of mathematical knowledge to function effectively and efficiently in the society. The subject matter of Mathematics has to do with the creation of the human mind and concerned basically with ideas, processes, logic and reasoning. Questions that arise in our environment are answered using the knowledge of Mathematics either knowingly or unknowingly. It is therefore viewed as a body of knowledge whose concepts used for solving problems in our environment. No wonder Kayode (2023) described it as a service subject since it exists in all areas of human endeavour.

Academic performance of students in mathematics refers to a student's success in the mathematical pursuit. Hailu (2024) defined academic performance as a measure of student achievement in any academic institution. It could also be in any academic subject. The measurement of academic performance of students is multifaceted and can be measured via grades, test scores, prediction models, or assessment. Students' academic performance in mathematics is influenced by factors such as cognitive skills, study habits, environmental factors, motivation and teaching methods. The academic performance of students in mathematics can be affected by teaching method. This may suggest why Ibanikoro and Taluno (2020) opined that the use of innovative instructional strategy could help students improve on their academic performance in mathematics. Strategies that are student-centered, engaging, and participatory help boosts students' academic performance.

George and Charles-Ogan (2023) posited that every classroom comprises of diverse learners with varied interest, learning attention span, socio-economic status, learning styles and ability levels. It becomes obvious that not all students learn the same curriculum content in the same manner in a given lesson. The varied ability levels of students pave way for teachers to provide students with choices on how they learn or demonstrate their understanding, and may adjust instruction based on students' progress and feedback. As a result, it is expected that teachers should consider priorities of each student within the classroom space based on needs, readiness, entry behavior, preferences, interest and ability level.

One way teachers can cater for the varied needs and interest of students in the classroom is by incorporating differentiated instruction. Lawson (2021) stated that differentiated instruction is an important element in the classroom designed to provide each student's with skills necessary to be successful in the learning process. The use of different instructional modes allows the opportunity to integrate various learning styles. Students are taught the same curriculum content and activities via varied instructional strategies while maintaining the instructional goal and objectives. Teachers can take care of the needs and interest of each student by adopting instructional methods and strategies that will foster the differentiation of instruction among students (Gardner, 2018).

Differentiated instruction is an instructional strategy in education that involves the recognition and response to the diverse learning needs, preferences, and abilities of students in the classroom. Instead of using a one-size-fits-all teaching strategy, differentiated instruction aims to tailor instruction to meet the individual needs of each student, allowing all learners to access and engage with the curriculum at their own level. Differentiated instruction allows teachers to meet each student at their zone of proximal development and offers challenging and appropriate prospects. Agu and Ogunshola (2022) asserted that the key principles of differentiated instruction are flexibility, individualization, collaboration, assessment. Differentiated instruction is beneficial because it helps teachers connect with different learning styles since not all students will respond to a class discussion, game, collaboration, video, or computer.

Nwangwu (2020) asserted that differentiated instruction is often implemented through a variety of strategies such as tiered assignments, flexible grouping, learning centres, and individualize learning plans. Differentiated instruction recognizes that students have varying levels of readiness, interests, and learning profiles. Teachers therefore, will have to tailor instruction to meet the unique needs of each student, providing support and challenges as needed. To prepare the young students for the new demands of modern world there is need to improve mathematical knowledge, applications and skills of the students. The learning outcomes of students in mathematics have not been encouraging due to a number of factors. The chalkboard and textbooks have continued to dominate classroom activities in most secondary schools. The methodology used to deliver instruction in mathematics has made students to have poor learning outcome in the subject. It is based on the above premises, that the researchers were spurred into investigating the effect of differentiated instruction on the learning outcome of senior secondary school students in Rivers State, Nigeria.

Statement of the Problem

Today's schools serve students from a variety of families and backgrounds, with a variety of learning styles. Every classroom is made up of students of diverse backgrounds, abilities and interests. This makes it imperative that the teacher should employ instructional strategies that will help students excel, regardless of their differences especially in mathematics. The researchers have observed as mathematics educators that most students do not like mathematics and also there exist a continuous poor performance of students in the subjects. The use of traditional teaching methods has taken the order of the day in most schools. There, is therefore an urgent need for teachers to embark on the use of innovative instructional strategies that can boost students' academic performance by differentiating the instruction. The teacher therefore, has to differentiate instruction to meet and cater for the needs of the diverse students in the classroom. Since most teachers do not employ the differentiated

instruction, it becomes worrisome. The researchers therefore have sought to investigate the effectiveness of the use of differentiated instruction in the mathematics classroom.

Aim and Objectives of the Study

The aim of this research investigation was to find out the effectiveness of the use of differentiated instruction on the academic performance of senior secondary school students in Rivers state, Nigeria. The objectives were to:

1. Determine whether there is a difference in the mean score performance of senior secondary school students taught mathematics using differentiated instruction and those taught using traditional teaching method.
2. Ascertain whether there is a difference in the mean score performance of the male and female senior secondary school students taught mathematics using differentiated instruction.

Research Questions

The two research posed below were answered.

1. What is the difference in the mean score performance of senior secondary school students taught mathematics using differentiated instruction and those taught using traditional teaching method?
2. What is the difference in the mean score performance of the male and female senior secondary school students taught mathematics using differentiated instruction?

Hypotheses

The null hypotheses formulated were tested at 0.05 significant level.

H₀₁: There is no significant difference in the mean score performance of senior secondary school students taught mathematics using differentiated instruction and those taught using traditional teaching method.

H₀₂: There is no significant difference in the mean score performance of the male and female senior secondary school students taught mathematics using differentiated instruction.

Research Design

The research designed used to conduct the study was the quasi experimental types which involved the use of non-randomized, non-equivalent intact class. The design made use one experimental and one control group. The dependent variable was instructional strategy, the independent variable was academic performance, while the moderating variable was gender.

Population of the Study

The population of the study comprised of all the senior secondary two (SS2) students in Port Harcourt Local Government Area of Rivers State, Nigeria.

Sample and Sampling Technique

A sample of one hundred and twelve (112) senior secondary two (SS2) students was selected from the population using the purposive sampling technique. Two schools were further purposively sampled, after which one intact class was selected from each of the two schools.

One intact class was randomly assigned the experimental group and the other the control group.

Instrument for Data Collection

The instrument used for the collection of data was titled Mathematics Performance Test “MPT”. The instrument had fifty multiple-choice test items with four options each. Only one option was the correct answer while the other three options were distractors. The scoring for each test item was two marks for any correct answer and zero for any incorrect answer. A table of specification was prepared for the allocation of questions based on topics, frequency, and level of cognitive learning domain.

Validity of the Instrument

The instrument, MPT was face and content validated by three mathematics educators who scrutinized the lesson plans and the instrument. The observations made by the mathematics educators were fully corrected to produce to a new and better version of the instrument before the administration to the sample students.

Reliability of the Instrument

The reliability of MPT was carried out using the test retest method in which the instrument was administered to twenty senior secondary school students who were not part of the sample students. A first test was given to the twenty students. After a forth night, the same instrument was given again to the same twenty students. This group of students did not receive any form of teaching with regards to the curriculum topics considered in this study. The two sets of tests were marked in percentage and the scores correlated using the Pearson product moment correlation statistic. The reliability statistic of MPT was 0.82.

Method of Data Collection

Students in both experimental and control groups were given a pretest of MPT. This was followed by the teaching of the mathematics topics to the student in the experimental and control groups. The topics taught were matrices and determinants. The students in the experimental group were taught with differentiated instruction while those in the control group were taught with the traditional teaching method. After the teaching of the topics, the students in both groups were given a posttest of MPT in which the test items were reshuffled to discourage the students from memorization of the former test. The scripts of both pretest and posttest were marked and graded in percentage. The scores were thereafter, recorded and sorted based on test type and gender.

Method of Data Analysis

Data was analyzed using mean and standard deviation to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 significant level.

Results

Research Question 1: What is the difference in the mean score performance of senior secondary school students taught mathematics using differentiated instruction and those taught using traditional teaching method?

Table 1: Mean and standard deviation on performance of students taught mathematics with differentiated instruction and those taught with traditional teaching method

Group	n	Pretest		Posttest		Performance	
		Mean	SD	Mean	SD	Mean Gain	Mean Difference
DFI	5230.14	10.06	64.09	12.40	33.95		
					12.47		
TTM	6036.20	11.27	57.68	13.62	21.48		

DFI = Differentiated Instruction
TTM = Traditional Teaching Method

The information in Table 1 showed the mean and standard deviation on the mean score performance of students that were taught matrices and determinants with differentiated instruction and those taught with traditional teaching method. From Table 1, it is observed that the students who were taught with differentiated instruction in the experimental group had a performance mean gain of 33.95 and those taught with traditional teaching method had a performance mean gain of 21.48. The result in Table 1 summarily indicated that the students taught with differentiated instruction performed better than those taught with traditional teaching method. The mean difference for the two groups was 12.47, and in favour of those taught with differentiated instruction.

Research Question 2: What is the difference in the mean score performance of the male and female senior secondary school students taught mathematics using differentiated instruction?

Table 2: Mean and standard deviation on performance of the male and female students taught mathematics with differentiated instruction

Gender	n	Pretest		Posttest		Performance	
		Mean	SD	Mean	SD	Mean Gain	Mean
Difference							
Male	23	28.35	10.06	62.50	12.40	34.15	
				0.40			
Female	29	31.93	11.27	65.68	13.62	33.75	

The information in Table 2 showed the mean and standard deviation on the mean score performance of the male and female students that were taught matrices and determinants with differentiated instruction. From Table 2, it is observed that the male students who were taught with differentiated instruction in the experimental group had a performance mean gain of 34.15, while the female students who were taught same topic with same differentiated instruction had a performance mean gain of 33.75. The result in Table 2 summarily indicated that the male students performed better than the female students in the same group. The mean difference for the two groups was 0.40, and in favour of the male students.

H₀₁: There is no significant difference in the mean score performance of senior secondary school students taught mathematics using differentiated instruction and those taught using traditional teaching method.

Table 3: Summary of ANCOVA on the difference in the performance of students taught mathematics with differentiated instruction and traditional teaching method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	13964.045	2	6928.023	140.705	.000	.231
Intercept	32764.488	1	32764.488	660.287	.000	.410
Group	11388.344	1	11388.344	229.504	.001	.118
Pretest	872.424	1	872.424	17.582	.000	.058
Error	9775.455	109	144.951			
Total	730600.000	112				
Corrected Total	23739.500	111				

a. R Squared = .588 (Adjusted R Square = .584)

Table 3 showed the presentation of the ANCOVA summary on the difference between the performance of students taught mathematics with differentiated instruction and traditional teaching method. The result indicated that there is a significant difference between the mean score performance of students taught mathematics with differentiated instruction and those taught with traditional teaching method ($F_{1, 109} = 17.582$, $p = .001$; $p < .05$, Partial eta squared = .058). H_{01} was therefore, rejected at 0.05 significant level since p-value was less than 0.05.

H₀₂: There is no significant difference in the mean score performance of the male and female senior secondary school students taught mathematics using differentiated instruction.

Table 4: Summary of ANCOVA on the difference in the performance of students taught mathematics with differentiated instruction based on gender

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2154.959	2	1077.48	6.667	.003	.287
Intercept	11786.300	1	11786.300	72.918	.000	.411
Gender	125.152	1	125.152	0.774	.375	.082
Pretest	2078.99	1	2078.99	12.862	.001	.046
Error	15355.500	49	161.637			
Total	450625.000	52				
Corrected Total	17510.500	51				

a. R Squared = .123 (Adjusted R Squared = .105)

Table 4 showed the presentation of the ANCOVA summary on the difference between the performance of students taught mathematics with differentiated instruction based on gender. The result indicated that there is no significant difference between the mean score performance of the male and female students taught mathematics with differentiated instruction ($F_{1, 49} = 0.774$, $p = .375$; $p > .05$, Partial eta squared = .082). H_{02} was therefore, rejected at 0.05 significant level since p-value was greater than 0.05.

Discussion of Findings

The result showed that the students who were taught with differentiated instruction in the experimental group had a performance mean gain of 33.95 and those taught with traditional teaching method had a performance mean gain of 21.48. This result indicated that the students taught with differentiated instruction performed better than those taught with traditional teaching method. The mean difference for the two groups was 12.47, and in favour of those taught with differentiated instruction. The subjection of the result to statistical analysis showed that there is a significant difference between the mean score performance of students taught mathematics with differentiated instruction and those taught with traditional teaching method ($F_{1, 109} = 17.582$, $p = .001$; $p < .05$, Partial eta squared = .058). This result is in agreement with the findings of Cabeserano (2025), Kara & Tekindur (2024) and Obafemi (2022) whose results showed that differentiated instruction improved the academic performance of students.

The result showed that the male students who were taught with differentiated instruction in the experimental group had a performance mean gain of 34.15, while the female students who were taught same topic with same differentiated instruction had a performance mean gain of 33.75. The result indicated that the male students performed better than the female students in the same group. When subjected to statistical analysis, the result indicated that there is no significant difference between the mean score performance of the male and female students taught mathematics with differentiated instruction ($F_{1, 49} = 0.774$, $p = .375$; $p > .05$, Partial eta squared = .082). This result corroborates with the result of Sebi and Wangar (2022) whose result showed that the male students taught with differentiated instruction performed better than the female students. However, this result does not agree with the finding of Akpan and Udeh (2021) whose finding showed that the female students performed higher than the male students. All the results showed that there was no significant difference in the performance of the male and female taught mathematics with differentiated instruction.

Conclusion

Based on the findings of this study it was concluded that the use of differentiated instruction improved the academic performance of senior secondary school students in mathematics. The use of differentiated improved students' performance since it involves the use of different instructional strategies which were tailored to the needs and interest of varied students during classroom instruction. It was also concluded that the use of differentiated instruction improve the academic performance of both the male and female students.

Recommendations

The following recommendations were made:

1. Mathematics teachers should implement the use of differentiated instruction to teach students mathematics.
2. The male students performed better than the female students, though a very slight difference, therefore, the differentiated instruction should be used for both gender.

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