



# Assessment of the Contributions of Different Teaching Methods to Students' Mathematics Achievement

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## Abstract

Students' level of learning and knowledge of mathematics has been a great concern in recent times in secondary school education. This study, therefore, investigated how the teachers' teaching approaches correlate and contribute to junior secondary school students' mathematics achievement in Lagos State, Nigeria. The study adopted a correlational research design. The study adopted a stratified sampling technique to select 30 junior secondary schools from the six existing educational districts, and a simple random technique was used to sample 900 students from the selected schools. Data was collected using the Teacher Teaching Methods Questionnaire ( $r = 0.76$ ) and the Mathematics Achievement Test ( $r = 0.71$ ). Data analysis was done using multiple regression with a significance level of less than 0.05. Combining all teachers' teaching methods (demonstration, group discussion/cooperative learning, lecture, discovery, and project) resulted in a multiple correlation coefficient ( $R$ ) of 0.237. The combination of independent variables explained the variance in the dependent variable, as indicated by the adjusted  $R^2$  of 0.051. Among the teaching methods considered, the group discussion/cooperative learning method ( $\beta = 0.219$ ,  $t = 5.217$ ) and the lecture method ( $\beta = 0.094$ ,  $t = 2.082$ ) both contributed positively and significantly to students' mathematics achievement. It is therefore important for mathematics teachers to identify and adopt the best methods to teach the subject.

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## 1. Introduction

Mathematics is one of the subjects that significantly contributes to a country's development in science and technology, which is why the 40th General Conference of UNESCO, convened on November 26, 2019, endorsed March 14 (Pi Day) as the International Day of Mathematics. Mathematics is appealing and deserves celebration; nonetheless, many students do not like and are afraid of the subject. The Nigerian Federal Government has recognised the importance of mathematics and has committed to promoting and enhancing its teaching and learning at all levels of education in Nigeria (FRN, 2013). The National Mathematics Centre (NMC) in Abuja offers a range of educational courses. Over time, the Centre has implemented specific Mathematics Improvement Projects (MIP) to enhance teaching mathematics and learning at the primary and secondary school levels. These programmes include teacher training workshops, the distribution of instructional materials to schools, and the creation of mathematical games to foster students' enthusiasm for learning thematic processes. Furthermore, it includes national incentive programmes such as scholarships, certificates of merit, and book prizes for mathematics students and teachers at educational institutions who have achieved a certain degree of excellence in mathematics instruction and acquisition at all educational stages. The evaluation techniques implemented by the public examining authorities could be one possible explanation for the slightly above-average performance of students in mathematics in recent times (Oladele, 2021).

Though the variables influencing students' performance in mathematics have been thoroughly examined, more research is still required, particularly in countries like Nigeria, where a high proportion of

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students achieve low scores in the subject (Oladele, Omole & Obiyo, 2022). Recent studies carried out in Nigeria suggest that a variety of factors, such as unfavourable learning environments, strained relationships between teachers and students, and the lack of instructional materials during mathematics classes, may have contributed to students' fear of mathematics and poor academic performance (Olaniyan & Salman, 2015; Nwoke and Ugwuegbulam, 2016). Numerous issues, such as a lack of laboratories and libraries, huge class numbers, a shortage of highly educated mathematics teachers, inadequate instructional facilities, and mathematics phobia, have been linked to poor student performance in mathematics (Sa'ad, Adamu, and Sadiq, 2014). Research by Jameel and Ali (2016) indicates that there is a link between students' poor performance in mathematics and the instructor's classroom methods. This discovery could aid in illuminating the underlying reasons for the poor performance. Fan (2012) emphasises the significance of teaching methods as a critical element, pointing out that while exceptional teacher practices are influenced by a range of factors, such as class size, the learning environment, and the needs of the students, teaching approaches remain an important factor.

Numerous African elementary and secondary schools have traditionally relied on non-cooperative methods for teaching mathematics (Ayaz & Sekerci, 2015; Kazemi & Ghorashi, 2012; Harlen, 2013). Experts note that due to overcrowded classrooms, most African schools continue to use traditional methods such as lecturing, which are often considered ineffective (Bofah & Hannula, 2015). According to Hassen (2015), the main reason for academic failure in Ethiopia is the widespread use of teacher-centered approaches, which tend to make students passive learners. Additionally, scholars have criticized traditional teaching methods for failing to address the diverse learning needs of students, especially those who struggle to grasp mathematical concepts (Carter, 2016; Ganyaupfu, 2013; Muema, Mulwa, & Mailu, 2018). On the other hand, Kazemi et al. (2012) presented conventional approaches that focus on teachers covering the material and completing the syllabus on schedule. Both Carbonneau, Kira, Scott, and James (2013) and Akaazua, Bolaji, Kajuru, Musa, and Bala (2017) contend that mathematical concepts are abstract mental constructions that ought to be communicated concretely through outward representations. Africa had to change its methods of teaching mathematics at the beginning of the twenty-first century. These new techniques were frequently modelled after Zambia, Zimbabwe, and Ethiopia, which had adopted new technology, particularly in science and mathematics, to transition from a knowledge-based to a competency-based curriculum. Since the transition from teacher-led to student-led methods, the use of physical manipulatives, the 5Es instructional paradigm, and inquiry-based learning (IBL) have all become more popular. There has been little research linking teachers' teaching methods and Mathematics achievement, and this study provides an opportunity to investigate the subject further. Teachers frequently articulate behavioural objectives in their lesson plans as they prepare to teach and instruct students to engage in group collaboration when addressing certain questions. However, they overlook the potential for more effective use of behavioural objectives and cooperative group work to motivate learners and potentially achieve superior results (Odhiambo & Wasike, 2016). This study fills this gap to ascertain the interaction of teaching methods components and their effects on students' Mathematics achievement. Also, it is essential to investigate the relationship between students' mathematics achievement and teachers' pedagogical approaches. It is hoped that by doing this, contributions to raising learners' mathematics proficiency could be achieved. Therefore, this study examined two objectives. Namely, to ascertain how much the teacher's instructional strategies such as project method, lecture style, group discussion/cooperative learning style, discovery technique, and demonstration method jointly contribute to student's success in mathematics, and to ascertain how much the different types of teaching strategies used by the teachers such as the project method, group discussion/cooperative learning strategy, lecture method, discovery technique, and demonstration method contribute independently to the student's success in mathematics. However, the following research questions were answered in this study:

1. What is the composite contribution of teachers' teaching methods (demonstration method, group discussion/cooperative learning method, lecture method, discovery method and project method) to students' achievement in Mathematics?
2. What is the relative contribution of teachers' teaching methods (demonstration method, group discussion/cooperative learning method, lecture method, discovery method and project method) to students' achievement in Mathematics?

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## 2. Methods

The study adopted a correlational research design to examine the relationships and contributions of key variables. The population consisted of all public Junior Secondary School Two (JSS 2) students in Lagos

State. Using a stratified sampling technique, 30 junior secondary schools were selected from the state's six educational districts, with five schools chosen from each district. A simple random sampling technique was then used to select 180 students from each of the five schools, resulting in a total of 900 students. To collect data, two structured instruments were developed and validated by experts in test construction: the *Teacher Teaching Methods Questionnaire (TTMQ)* and the *Junior Secondary School Mathematics Achievement Test (JSSMAT)*.

The teaching methods under study were implemented by teachers at different times, while the achievement test assessed students' knowledge based on the JSS 2 mathematics syllabus. A smaller group of students participated in a pilot test, yielding reliability coefficients of 0.76 for the TTMQ and 0.71 for the JSSMAT. Before administering the instruments, informed consent was obtained from school administrators, teachers, and students. Both TTMQ and JSSMAT were administered in a paper-and-pencil format. Students responded to the questionnaire based on their teachers' instructional practices. The collected data were analyzed using multiple regression at a significance level of  $\alpha = 0.05$ .

### 3. Results & Discussions

**Research Question 1:** What is the composite contribution of components of teachers' teaching methods (demonstration method, group discussion/cooperative learning method, lecture method, discovery method and project method) to students' achievement in Mathematics?

**Table 1.** Teachers' Teaching Methods Joint Contribution to the Students' Achievement in Mathematics

Analysis of Variance					
Sources of Variance	Sum of Squares	Df	Mean Square	F	p-value
Regression	2863.11	5	572.66	10.62	0.00
Residual	48203.64	894	<b>53.92</b>		
<b>Total</b>	<b>51066.75</b>	<b>899</b>			

Multiple R = 0.24; R Square = 0.06; Adjusted R Square = 0.05; Standard Error = 7.34

Table 1 indicates that the overall multiple correlation coefficients (R) for all combined components of teachers' teaching methods, namely demonstration method, group discussion, cooperative learning method, lecture method, discovery method, and project method, were 0.24. The adjusted R<sup>2</sup>, which reflects the proportion of variance in the dependent variable attributed to the collective impact of the teachers' teaching methods components, was recorded at 0.05. This implies that all the teachers' teaching methods components, demonstration method, group discussion/cooperative learning method, lecture method, discovery method, and project method made a 5% contribution to the variance in students' achievement in Mathematics. Regression ANOVA produced ( $F_{(899)} = 10.62$ ). This implies that a joint contribution of the components of teachers' teaching methods to students' achievement in Mathematics is significant.

From the values of the standardized regression weights associated with the independent variable in Table 1, there is a clear indication that teachers' teaching methods positively contribute to students' Mathematics achievement but may not have a significant effect on students' overall school performance. This implies that when teachers combine more than one teaching method, it is likely to improve the mathematics achievement of students.

**Research Question 2:** What is the relative contribution of components of teachers' teaching methods (demonstration method, group discussion/cooperative learning method, lecture method, discovery method and project method) to students' achievement in Mathematics?

From Table 2, it is evident that some of the components of teachers' teaching methods contributed positively or negatively to the prediction of students' achievement in Mathematics. Group Discussion/Cooperative Learning Method with this feature ( $\beta = .219$ ,  $t = 5.217$ ,  $p < 0.05$ ) and lecture method with this feature ( $\beta = .094$ ,  $t = 2.082$ ,  $p < 0.05$ ) contributed positively and significantly in the prediction of students' achievement in Mathematics while discovery method with this feature ( $\beta = .055$ ,  $t = 1.344$ ,  $p > 0.05$ ) contributed positively, but insignificantly in the prediction of students' achievement in Mathematics. However, the prediction of students' achievement in mathematics was unfavourably and insignificantly impacted by the project approach ( $\beta = -.057$ ,  $t = -1.277$ ,  $p > 0.05$ ) and demonstration technique ( $\beta = -.074$ ,  $t = -1.412$ ,  $p > 0.05$ ). This suggests that students' success in mathematics is mostly determined by the group

discussion/cooperative learning approach and the lecture method. In a similar vein, there is ample evidence that the project and demonstration methods do not improve students' performance in mathematics. The study unequivocally shows that, of the five (5) teachers' methods of instruction, group discussions and cooperative learning are the most effective in raising students' achievement in mathematics.

**Table 2.** Relative Contribution of Components of Teachers' Teaching

Model	Unstandardized Coefficients		Standardized Coefficients	t	p-value
	B	Std. Error	Beta		
Constant	11.784	2.368			0.00
Demonstration method	-0.105	0.074	-0.074	4.977	0.16
Group Discussion/ Cooperative Learning Method	0.420	0.080	0.219	5.217	0.00
Lecture Method	0.222	0.107	0.094	2.082	0.04
Discovery Method	0.212	0.157	0.055	1.344	0.18
Project Method	-0.150	0.117	-0.057	-1.277	0.20

The findings of this study revealed that when teachers combine different teaching methods during the teaching and learning of mathematics, such as the group discussion/cooperative learning method and lecture method, the students' achievement in the subject tends to improve. This finding aligns with the findings of (Eniayeju, 2010; Hiebert, & Grouws, 2007), who reported that there was a positive effect of teaching methods employed by teachers on the academic achievement of the students in Mathematics. It shows that using more than one method to teach mathematics gives the student an understanding of the subject. Also, the use of signs, symbols, terminologies, numbers, and mathematical expressions is unique to mathematics. Proper use of these elements enhances the subject's conceptualization (Udofia & Etuk, 2014). The thesis of Odhiambo & Wasike (2016) posits that the use of innovative interactive instructional strategies by the teacher enhances students' capacity to acquire mathematical knowledge, regardless of the subject matter's complexity. This approach offers the benefit of improving and cultivating students' motivation to learn mathematics. In his study on the impact of comprehending the language of mathematics on the academic achievement of secondary school pupils in Plateau State, Ishaku (2005) discovered that understanding the language of mathematics had a noteworthy influence on performance in the subject. The language of instruction by the teachers has an impact on learners' fluency in the language of mathematics.

The predictive value of 5% showed a very low prediction of students' achievement in Mathematics. Out of the five (5) components of teachers' teaching methods, only two (2) are significant, that is, the group discussion/cooperative learning method and the lecture method. The remaining three (3) components, that is, the discovery method, project method and demonstration method, are not significant. It can be deduced that the impact of these non-significant variables reduced the predictive value. This result may mean that the discovery method, project method and demonstration method have little impact on students' achievement in Mathematics. The study indicates clearly that out of the five (5) teachers' teaching methods, the group discussion/cooperative learning method is the most potent contributor to students' achievement in Mathematics, followed by the lecture method. The finding of this study is in agreement with the findings of (Eniayeju, 2010 and Okafor, 2007) in a separate study conducted in Primary and Secondary Schools respectively on the effect of cooperative learning strategy on the achievement of Primary six pupils and Senior Secondary two (SS II) students in Mathematics, reported that pupils/students (experimental group) exposed to cooperative learning strategy performed better than those (control group) exposed to other teaching methods. Similarly, Ozsoy & Yildiz (2004) in their study on the effect of the learning together technique of the cooperative learning method on student achievement in mathematics reported a significant difference between the results of experimental and control groups and affirmed that the learning together technique of cooperative learning method is more effective than traditional teaching methods. Also, Mohammed (2006) in his study affirmed that students tend to achieve significantly better if they work in small groups than if they listen to a lecture as a whole class. However, the findings of this study that revealed the negative and non-significant contribution of project method and demonstration method on students' achievement in Mathematics as shown in Table 2 tends to agree with the findings of some researchers (Ezenweorah, 2007; Ezeamenyi, 2010) who reported from their respective findings that the teaching methods tested did not increase the students' academic achievement in Mathematics.

The findings of this study are also in line with the research studies of (Hattie, 2009; Muijs & Reynolds, 2011; Cobb & Jackson, 2011; Fuson & Kalchman, 2012; Hiebert & Grouws, 2007) which underscore the

significance of teachers' teaching methods in influencing junior secondary school students' mathematics achievement. Through an examination of different instructional approaches, including traditional lecture-based instruction and active learning strategies, this study sheds light on the differential effects of teaching methods on students' mathematics performance. The findings of these studies revealed that students engaged in active learning activities, such as problem-based learning and cooperative learning, exhibit higher levels of mathematics achievement compared to their counterparts in traditional lecture-based. This shows the importance of adopting student-centred instructional practices to enhance mathematics learning outcomes in junior secondary schools. Similarly, the findings of this study is also in consonance with Johnson, Johnson & Smith (2014), who explored the benefits of group discussion and cooperative learning methods in improving students' mathematics achievement. Their research demonstrated that collaborative activities promote peer interaction, communication skills, and collective problem-solving, leading to enhanced learning outcomes.

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#### 4. Conclusion

The study revealed that all the teachers' teaching methods components, demonstration method, group discussion/cooperative learning method, lecture method, discovery method, and project method made a 5% contribution to the variance in Mathematics. This demonstrates how important it is for educators to employ successful teaching techniques for learners to gain a deeper comprehension and knowledge and exhibit higher achievement in Mathematics. The results of the study also demonstrate that the group discussion/cooperative learning method and lecture method contributed positively and significantly in the prediction of students' achievement in Mathematics, while the discovery method contributed positively, but insignificantly in the prediction of students' achievement in Mathematics. However, the prediction of students' achievement in mathematics was negatively and insignificantly impacted by the project approach and demonstration technique. In essence, the study discovered that students' success in mathematics is mostly determined by the group discussion/cooperative learning approach and the lecture method. The study unequivocally shows that out of the five (5) teachers' methods of instruction, group discussions/cooperative learning is the most effective in raising students' achievement in mathematics. Therefore, teachers' appropriate teaching methods can substantially contribute to improved Mathematics achievement. It is recommended that Mathematics teachers should employ appropriate teaching methods that align with effective pedagogical practices.

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