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Enhancing Mathematics Performance among Students: The Role of Expository Technique in Ekiti State, Nigeria

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Abstract
This quasi-experimental study examined the impact of expository technique on secondary school students' mathematics performance. A pretest-posttest design was employed, involving 217 Senior Secondary School Two (SSS II) students selected from 206 public secondary schools in Ekiti State, Nigeria. The Mathematics Performance Test (MPT) was used for data collection, with established face, content, and construct validity. The test-retest reliability coefficient of 0.89 ensured the instrument's consistency. Descriptive and inferential statistics, including ANOVA and ANCOVA, were used to analyze the data. The results showed no significant pre-test differences between the experimental (expository technique) and control (conventional method) groups. However, significant post-test mean score differences favoured the expository technique group, indicating its effectiveness in enhancing mathematics performance. Additionally, no significant gender differences were observed, suggesting that expository technique benefits both male and female students equally. The study highlights the potential of the expository technique to promote gender equity in mathematics education.

Keywords: Expository Technique, Mathematics Performance, Secondary School Students, Gender, Nigeria

Introduction

Mathematics is a foundational subject that forms the backbone of numerous academic disciplines and real-world applications. In Nigeria, like many other countries, mathematics education is of paramount importance, as it plays a crucial role in shaping students' cognitive development, problem-solving abilities, and future career prospects. However, despite its significance, mathematics continues to be a challenging subject for many students, with performance outcomes varying across different regions and educational contexts. Ekiti State, located in southwestern Nigeria, is home to a diverse population of students with varying socio-economic backgrounds and educational experiences. Within this context, the effectiveness of teaching methods, particularly expository techniques, holds significant implications for students' performance in mathematics. The exploration of how expository techniques influence students' performance in mathematics in Ekiti State is essential for several reasons. Firstly, it provides insights into the efficacy of current instructional practices and pedagogical approaches employed by educators in the region. By evaluating the impact of different expository techniques, educators can identify strategies that effectively engage students, promote deeper understanding, and improve academic achievement in mathematics.

Secondly, understanding the effect of expository techniques on students' performance in mathematics can inform curriculum development and instructional design. As educators strive to align teaching methods with learning objectives and educational standards, insights into the effectiveness of expository techniques can guide the selection and implementation of appropriate instructional strategies tailored to the needs of students in Ekiti State. Moreover, examining the relationship between expository techniques and students' performance in mathematics contributes to the broader discourse on educational equity and access. In a diverse educational landscape like Ekiti State, where students come from varied socio-economic backgrounds and have different learning needs,

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identifying effective instructional methods becomes imperative to ensure equitable learning opportunities for all students.

Furthermore, the study of expository techniques in mathematics education aligns with global efforts to enhance STEM (Science, Technology, Engineering, and Mathematics) education and promote numeracy skills among students. In an increasingly interconnected and technologically driven world, proficiency in mathematics is essential for success in various academic and professional domains, making it crucial to explore effective teaching methods that foster mathematical competence and confidence among students. Additionally, investigating the effect of expository techniques on students' performance in mathematics contributes to the body of empirical research on mathematics education in Nigeria. By generating evidence-based insights into the relationship between instructional practices and academic outcomes, this research can inform policy decisions and educational reforms aimed at improving mathematics education at the regional and national levels. In light of these considerations, this study seeks to examine the effect of expository techniques on students' performance in mathematics in Ekiti State, Nigeria. By analyzing the impact on students' learning outcomes, this research aims to provide valuable insights for educators, policymakers, and stakeholders invested in enhancing mathematics education and promoting academic excellence in the region.

Expository Technique of Teaching Mathematics

Mathematics, often hailed as the language of physical sciences, holds a profound significance in its symbolic abstraction. Mere comprehension of mathematical concepts falls short; it's imperative for children to articulate and manipulate these symbols effectively. Otherwise, presented symbols become meaningless abstractions devoid of real-world context, leading to rote learning (Jones, & Childers, 2021). In the realm of arithmetic and algebra, students grapple not with tangible facts but with abstract symbols. For a struggling student, deciphering the meaning behind these symbols becomes a daunting task. The language of mathematics evolves progressively and demands diligent practice for mastery (Popoola, 2015). This linguistic proficiency in mathematics serves as a solid foundation for other sciences, making expository teaching an ideal method for imparting mathematical concepts. Recent research has highlighted several strategies and approaches that educators can employ to enhance expository techniques and improve students' understanding of mathematical concepts. One important aspect of expository technique in teaching mathematics is the use of visual aids and manipulatives. Visual representations, such as diagrams, graphs, and models, can help students visualize abstract concepts and make connections between different mathematical ideas (Clements & Sarama, 2011). For example, the use of concrete manipulatives, such as blocks or geometric shapes, can help students develop a deeper understanding of geometric concepts like area and volume (Goulding & Suggate, 2020).

Another effective expository technique is the use of real-world contexts and applications. By connecting mathematical concepts to real-world scenarios, educators can captivate students' interest and illustrate the practical applications of mathematics, making it more meaningful and relevant to their lives (Hiebert & Grouws, 2007). For instance, teaching fractions using examples from cooking or money management can help students understand the practical importance of fractional concepts (Lamon, 2020). Additionally, recent research has emphasized the importance of incorporating inquiry-based learning approaches in mathematics instruction. Inquiry-based learning encourages students to explore mathematical concepts through problem-solving, investigation, and discovery (Lesh & Doerr, 2003). By posing open-ended questions and providing opportunities for exploration, educators can foster students' curiosity and develop their problem-solving skills (Leikin & Zazkis, 2018). Furthermore, recent studies have highlighted the significance of fostering a positive and supportive learning environment in mathematics classrooms. Creating a classroom culture that values mistakes as opportunities for learning and encourages collaboration can help students feel more confident and motivated to engage with mathematical concepts (Boaler, 2016). Additionally, providing timely and constructive feedback can help students understand their strengths and areas for improvement (Hattie & Timperley, 2007). The vitality of mathematics extends beyond its disciplinary boundaries, serving as a cornerstone for scientific and engineering disciplines. Its teaching mandates well-trained educators equipped with comprehensive knowledge of concept learning and teaching methodologies (Fabiyi & Binuyo, 2022). The effective use of expository techniques elucidates mathematical concepts by simplifying its language and registers, fostering meaningful and enduring comprehension (Ekwueme et al., 2012). Proper execution of expository teaching transcends mere regurgitation of facts, embodying the artistry of a master educator.

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Summarily, the expository teaching method is a robust pedagogical approach to conveying mathematical concepts, fostering deep understanding, and preparing students for the rigours of scientific inquiry and analysis.

Exploring Gender Disparities in Mathematics Performance

The disparity in Mathematics performance between genders has spurred extensive research, highlighting the crucial need for a literature review on gender and academic achievement, particularly in Mathematics, which serves as the cornerstone for technological advancement. Gender disparities in the learning outcomes of Mathematics and Science-related subjects are often attributed to a combination of genetic variances and socio-cultural influences. Studies suggest that inherent genetic differences between males and females, alongside socio-cultural forces, contribute to discrepancies in Basic Science achievement and ability (Smith, 2018). Genetic variances play a role in shaping cognitive abilities, potentially leading to variations in how individuals of different genders approach and excel in Mathematics and Science subjects (Jones & Brown, 2019). Additionally, socio-cultural factors such as family dynamics, neighborhood environments, peer interactions, school influences, training and experience, and cultural practices also impact learning outcomes in these disciplines (Miller, 2020). Research indicates that attitudes and expectations towards gender-specific academic pursuits can significantly influence a student's interest and performance in Mathematics and Science-related subjects (Lubienski &Wischow, 2020). Moreover, peer interactions within academic settings and cultural norms regarding gender roles can further exacerbate or mitigate gender disparities in educational outcomes (Garcia & Martinez, 2017).
Numerous studies have consistently shown that male students tend to outperform their female counterparts in Mathematics and sciences (Shelly, 2016; Ibok, 2015; Akinboboye et al., 2014). This imbalance is evident in the enrollment patterns, with fewer girls opting for core science subjects like Chemistry, Mathematics, Physics, and Further Mathematics, while majorities gravitate towards subjects like Home Economics and Commerce. However, contrasting findings suggest no significant disparity in Mathematics performance between genders (Stoet & Geary, 2021).

Some studies reveal nuanced differences, such as male students excelling in geometry, computation, and spatial visualization while others show that female students outperform males under certain instructional strategies like concept mapping (Keller & Dauenheimer, 2020). Investigations into teaching methodologies also play a pivotal role. For instance, Ofuonyebuzor (2017) found that guided discovery teaching method yielded better academic achievement in Mathematics compared to lecture-based methods, particularly in urban settings. Similarly, Omeodu and Fredrick (2019) demonstrated that employing game-based teaching methods led to improved understanding of quadratic equations compared to traditional expository methods. Udo (2011) examined various instructional approaches and their impact on students' performance in redox reactions, highlighting the effectiveness of problem-solving methods over guided discovery and expository techniques. Meanwhile, Uba et al. (2019) explored the effectiveness of mastery learning compared to expository approaches in teaching English language, revealing significant improvements in achievement and retention among students taught using mastery learning strategies. Despite variations in geographical locations and methodological approaches, the overarching goal remains consistent: to understand the factors influencing academic performance, particularly in Mathematics, and to address gender disparities in educational outcomes. Thus, this study aims to investigate the impact of the expository technique on students' Mathematics performance, while also examining gender differences in Mathematics performance within Ekiti State.

Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance:

1. The mean performance scores of students in Mathematics will be the same for both the expository technique and conventional method groups before instruction.
2. There will be no significant interaction effect between teaching method (expository technique vs. conventional method) and time (pre-test vs. post-test) on students' performance mean scores in Mathematics.
3. The mean performance scores of male and female students in Mathematics will be equal when taught using the expository technique.

Methodology

This study employed a randomised pretest-posttest control group design, a type of quasi-experimental research. The design consisted of two groups: an experimental group, which received the treatment (expository technique),

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and a control group, which received the conventional method. Randomisation of classes into experimental and control groups ensured minimized bias and enhanced internal validity. This is symbolically represented thus:

Group A	R	O1	X1	O2
Group B	R	O3		O4

Where groups A, and B are the schools randomly assigned to experimental and control group. X1 is the treatment given to group A and it is the use of the expository teaching method, and Group B, the control group.. O1 and O3 are the two groups pretest observations, while O2 and O4 are the corresponding posttest observations for groups A and B. R connotes randomization. This study aimed to measure the impact of a new teaching method on students' math performance. To do this, the researcher gave a math test to two groups of students - one group received the new teaching method, while the other group received the traditional method. The test was given before and after the teaching methods were applied. The study involved 108 Senior Secondary School Two (SSS II) students selected from two public secondary schools in Ekiti State, Nigeria. A multistage sampling procedure was used, involving the selection of one Local Government Area (LGA) using a simple random sampling technique. Stage two involve purposive selection of two public secondary schools. Stage three involves the selection of students using intact classes. Schools were assigned to experimental and control groups using a simple random sampling technique. The Mathematics Performance Test (MPT) was used to measure students' performance before and after treatments. The test consisted of two sections, section A contains demographic variables, and section B contains 30 multiple-choice questions with four options (A-D). Test-retest method was used to determine reliability, with a coefficient of 0.89. Descriptive and Inferential Statistics were used to analyse data collected. Hypotheses 1 and 2 were tested using Analysis of Variance (ANOVA). Hypothesis 3 was tested using Analysis of Covariance (ANCOVA). All hypotheses were tested at a 0.05 level of significance. The choice of ANCOVA was because it provides us with an elegant means of reducing bias as well as within-groups error in the analysis. Also, it helps to determine whether the independent variable is indeed having effect and the influence of the extraneous variable on the dependent variable is statistically controlled. The purpose of pre-test was to establish learning outcomes and ensured homogeneity between experimental and control groups while post-test helps to measured improvement in students' performance towards Mathematics after treatments.

Results

Test of Hypotheses

Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, homogeneity of regression slope and independence of treatment.

Hypothesis 1: The mean performance scores of students in Mathematics will be the same for both the expository technique and conventional method groups before instruction.

To test this hypothesis, the pre-test mean scores of students in the experimental (expository techniques) and control (conventional methods) groups were calculated and compared using Analysis of Variance (ANOVA) at a 0.05 significance level. The results are presented in Table 1.

Table 1: Analysis of Variance (ANOVA) of students' performance in Mathematics before treatments

Source	SS	Df	MS	F	p
Between Groups	25.76	2	8.59		
Within Groups	1183.58	102	5.56	1.55	0.204
Total	1209.336	104		*	

p>0.05

The ANOVA results presented in Table 1 indicate that the computed F-value (1.545) is not significant at the 0.05 level, with a corresponding p-value > 0.05. This non-significant result leads to the failure to reject the null hypothesis. Therefore, it can be concluded that there is no significant difference in the pre-treatment performance mean scores of students exposed to expository techniques and conventional methods in Mathematics.

Hypothesis 2: There will be no significant interaction effect between teaching method (expository technique vs. conventional method) and time (pre-test vs. post-test) on students' performance mean scores in Mathematics.

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To test this hypothesis, the performance mean scores of students exposed to the expository technique and conventional method in Mathematics were computed and compared before and after treatments. Analysis of Covariance (ANCOVA) was used to determine statistical significance at a 0.05 level. The results are presented in Table 2.

Table 2: ANCOVA Results for Mathematics Performance by Treatment

Source	SS	Df	MS	F	P
Corrected Model	1301.55	2	325.39	60.93	0.00
Covariate (Pretest)	797.40	1	797.40	149.32	0.00
Group	687.83	1	229.28	42.94	0.00*
Error	1132.10	105	5.34		
Total	31397.00	108			
Corrected Total	2433.64	107			

***p<0.05**

The ANCOVA results presented in Table 2 indicate that the computed F-value (42.94) is significant at the 0.05 level, with a corresponding p-value < 0.05. This significant result leads to the rejection of the null hypothesis. Therefore, it can be concluded that there is a significant difference in the performance mean scores of students taught Mathematics using expository techniques and conventional methods, before and after treatment. To further investigate the effect of treatment on Mathematics performance, Multiple Classification Analysis (MCA) was conducted, as shown in Table 3.

Table 3: MCA Results for Mathematics Performance by Treatment

Variable + Category	N	Adjusted Devn'	Eta^2	Adjusted For Independent + Covariate	Beta
Expository	55	0.09		0.06	0.50
Conventional	53	-1.59	0.54	-1.75	
Multiple R					0.50
Multiple R^2					0.25
Grand Mean					11.55

The Multiple Classification Analysis (MCA) results presented in Table 3 reveal that students exposed to the expository strategy had an adjusted mean score of 11.61 (11.55 + 0.06), whereas students in the control group had an adjusted mean score of 9.80 (11.33 + (-1.75). This suggests that the expository instructional strategy was more effective in enhancing students' Mathematics performance. The treatment accounted for 54% of the observed variance in students' Mathematics performance ($Eta^2 = 0.54$), indicating a substantial effect of the expository strategy.

Hypothesis 3: The mean performance scores of male and female students in Mathematics will be equal when taught using the expository technique.

To test this hypothesis, the performance mean scores of male and female students in Mathematics were computed and compared before and after treatment. Analysis of Covariance (ANCOVA) was used to determine statistical significance at a 0.05 level.

Table 13: ANCOVA Results for Mathematics Performance by Gender

Source	SS	Df	MS	F	P
Corrected Model	784.77	2	130.80	22.43	0.00
Covariate (Pretest)	445.07	1	445.07	76.33	0.00
Sex	6.34	1	6.34	1.09	0.30
Group	453.61	2	226.81	38.90	0.00
Sex* Group	0.45	2	0.22	0.04	0.96
Error	915.49	104	5.83		
Total	25581.00	108			
Corrected Total	1700.26	107			

p>0.05

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The ANCOVA results presented in Table 13 indicate that there is no significant interaction effect. The computed F-value (0.04) for the interaction between treatment and gender was not significant at the 0.05 level ($p > 0.05$). Therefore, the null hypothesis was not rejected, suggesting no significant interactive effects of treatment and gender on students' Mathematics performance. The main effect of gender on Mathematics performance was not statistically significant at the 0.05 level ($F_{1,157} = 1.09$, $p > 0.05$). However, the treatment had a significant effect on students' Mathematics performance at the 0.05 level of significance ($F_{2,157} = 38.90$, $p < 0.05$). This suggests that the expository technique had a significant impact on students' Mathematics performance.

Discussion

The study explored the impact of the expository teaching method on the Mathematical performance of secondary school students in Ekiti State, Nigeria. The study investigated the effects of using the expository technique on secondary school students' performance in Mathematics in Ekiti State, Nigeria. The findings revealed several key insights into the impact of this instructional approach.

The initial analysis indicated no significant difference in the pre-test performance of students in Mathematics between the experimental (expository technique) and control (conventional method) groups. This suggests that students in both groups had similar baseline levels of understanding and competence in Mathematics before the intervention.

Notably, the post-test means scores revealed significant differences between the experimental and control groups, suggesting that the instructional method used had a substantial impact on student outcomes. This implies that the use of the expository technique to teach Mathematical terms, symbols, and notations significantly enhanced the performance of students in Mathematics compared to the conventional teaching method. This supported the findings of Clements and Sarama (2011), who observed that visual representations, such as diagrams, graphs, and models, can help students visualise abstract concepts and make connections between different mathematical ideas. It also agrees with the findings of Goulding and Suggate (2020), who observed that the use of concrete manipulatives, such as blocks or geometric shapes, can help students develop a deeper understanding of geometric concepts like area and volume.

The results of the Multiple Classification Analysis (MCA) further underscored the effectiveness of expository instructional strategy, revealing that students exposed to this method exhibited higher adjusted mean scores in Mathematics compared to those in the control group. The treatment accounted for a substantial portion of the observed variance in students' performance, indicating its significant impact.

These findings have important implications for teaching practice, suggesting that educators in Ekiti State and beyond can benefit from incorporating expository techniques into their instructional strategies for Mathematics. By presenting content in a clear, structured manner with contextual elaboration and illustrative examples, teachers can facilitate deeper understanding and retention of mathematical concepts among students.

The study also examined gender differences in students' performance in Mathematics and the potential interaction between gender and instructional methods. Previous research has highlighted gender disparities in Mathematics performance, with male students often outperforming their female counterparts. However, in this study, no significant gender difference in performance was observed. This corroborated the findings of Stoet and Geary (2021) and disagrees with the findings of Akinboboye et al (2014) and Keller and Dauenheimer (2020). In this study, both male and female students benefited equally from the use of the expository technique, indicating that this instructional approach can be effective regardless of gender. The analysis of covariance (ANCOVA) results showed no significant interaction between the expository technique and gender on students' mathematics performance, indicating that the effectiveness of this instructional method was consistent for both males and females. While gender disparities in Mathematics performance have been documented in various contexts, the findings of this study suggest that effective instructional strategies, such as expository techniques have the potential to mitigate these disparities. By providing all students, regardless of gender, with access to high-quality teaching and learning experiences, educators can promote gender equity in Mathematics education.

Conclusion

This study contributes valuable insights into the role of expository technique in enhancing students' performance in Mathematics in Ekiti State, Nigeria. The findings underscore the effectiveness of this instructional approach in

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facilitating deeper understanding and improving academic achievement in Mathematics, with implications for teaching practice and educational policy. Furthermore, the study highlights the importance of addressing gender disparities in Mathematics education and the potential of effective instructional strategies to promote gender equity. By adopting evidence-based practices and prioritising inclusive teaching methods, educators can create learning environments that support the academic success of all students, regardless of gender or background.

Recommendations

1. Pedagogical Practice: Educators should integrate expository techniques into their teaching methodologies to enhance students' comprehension and retention of mathematical concepts. Training programs and workshops should be organized to familiarize teachers with effective expository teaching strategies.
2. Curriculum Development: Educational authorities should consider revising the mathematics curriculum to emphasize the use of expository techniques. Textbooks and instructional materials should be designed to facilitate expository learning, providing clear explanations and examples for students.
3. Teacher Professional Development: Continuous professional development programs should be implemented to equip mathematics teachers with the necessary skills and knowledge to effectively utilize expository techniques in their classrooms. Peer collaboration and mentorship can also support teachers in refining their expository teaching practices.
4. Research and Evaluation: Further research is needed to explore the long-term effects of expository techniques on students' mathematical proficiency and academic achievement. Longitudinal studies can provide insights into the sustainability of the observed improvements and identify any potential challenges or limitations associated with expository instruction.

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