

REINFORCEMENT STRATEGIES AND ACADEMIC PERFORMANCE OF STUDENTS IN MATHEMATICS IN SECONDARY SCHOOLS IN UYO LOCAL GOVERNMENT AREA

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ABSTRACT

*The study analyzed the reinforcement strategies and the academic performance of students in mathematics. The survey research design was adopted for this study. The population of the study comprised all Senior Secondary School (SSS) students and Mathematics teachers in public secondary schools in Uyo Local Government Area. A multistage sampling technique was used to select a Sample size of 200 Senior Secondary School students and 20 Mathematics teachers was selected for the study. The primary instrument for data collection was a researcher-designed questionnaire titled “Enforcement Strategies and the Academic Performance of Students in Mathematics Questionnaire” (ESAPSMQ). The instrument was subjected to content and face validation by three experts from the Department of Educational Foundations, Guidance, and Counseling at the University of Uyo. The reliability of the instrument was established through a pilot study conducted in a public secondary school outside the selected sample in Uyo Local Government Area. Data collected were analyzed using both descriptive statistical methods. T-test, was employed to test the hypotheses at a 0.05 level of significance. The study showed that there was **significant difference in the types of reinforcement strategies employed by Mathematics teachers in secondary schools in Uyo Local Government Area**. It was concluded that reinforcement strategies play a crucial role in enhancing students' academic performance in Mathematics by motivating learning and improving retention. Positive reinforcement, such as rewards and praise, boosts confidence and encourages consistent effort. Negative reinforcement, when applied correctly, helps students overcome fear and develop problem-solving skills. Immediate feedback strengthens understanding, while delayed reinforcement may reduce motivation. One of the recommendations made was that teachers should use a mix of reinforcement strategies, including verbal praise, tangible rewards, immediate feedback, and non-verbal cues, to cater to diverse student needs and learning preferences.*

Keywords: Reinforcement Strategies, Academic Performance, Students, and Mathematics

Introduction

Education serves as a fundamental driver of social and economic growth, fostering innovation, reducing poverty, and enhancing social cohesion (Organisation for Economic Co-operation and Development, OECD, 2024). Therefore, academic performance, particularly in core subjects like Mathematics, is a key indicator of the quality of education being provided. The importance of Mathematics in most fields of human endeavor cannot be underestimated. Its usefulness in science, mathematical and technological activities as well as commerce,

economics, education, and even humanities is almost at par with the importance of education as a whole (Tella, 2008).

In Nigeria, the relevance of Mathematics is underscored by its integral role in the education system. It is one of the core subjects offered in primary and post-primary institutions, and attaining a pass credit level in Mathematics is a prerequisite for admission into post-secondary institutions, reflecting its crucial importance. The practical implications of Mathematics go beyond the classroom, extending to job opportunities and recruitment exercises. Mathematical questions are a consistent component of aptitude tests for employment, promotion, and placement, further emphasizing the subject's relevance. At both national and global levels, there is a unanimous consensus on the pivotal role of scientific and technological advancements in the economic development, viability, and stability of nations in the 21st century. These advancements are contingent on a robust foundation in Mathematics education, making it a prerequisite for national prosperity. Therefore, Mathematics is not merely an academic subject; it is a fundamental tool that underpins progress and success. Therefore, the relevance of Mathematics in Nigeria demands effective teachers' reinforcement strategies.

Aliyu, Umar, & Muhammad (2023) explain that the effectiveness of classroom management and behaviour is always determined by reinforcement. As a result, it may have an impact on pupils' motivation to learn Mathematics. This is because all pupils will be greatly driven to learn Mathematics in order to win the prize (reinforcer) if a teacher tells the class that a prize will be given to any of them who attempts and gets all the answers to these questions correctly. The entire class will probably be inspired (stimulus condition) to continuing earning the reward if he/she properly answers the questions (response) and receives the promised prize. They conclude that reinforcement may have an impact on a student's academic performance in Mathematics. According to Ohanye (2021), academic performance refers to pupils' ability to apply classroom knowledge and abilities, whether through writing or spoken communication. Academic performance is typically measured by grades or marks issued by teachers or examination boards, such as the West African Examination Council, based on established standards. The quality of education is typically measured by students' academic performance. Academic performance encompasses the extent of students' success in their educational endeavors (Imene, 2018). However, academic achievement is not limited to excellence solely within the academic disciplines taught in the classroom; it extends to encompass extracurricular activities as well. This broader definition considers various activities outside the classroom, such as sports, behavior, confidence, communication skills, punctuality, assertiveness, arts, culture, and more. Scholars have identified an array of factors that influence students' academic achievement, such as their motivation, study habits, health, the learning environment, the support they receive from their family, and teachers' personal factors (Tella, 2008; Adeniyi, Ogundele, and Odetola, 2014; El-Omari, 2016). Apart from academic achievement, some scholars also argue that students' academic performance in Mathematics is influenced by gender.

Statement of Problem

Despite the paramount importance of Mathematics in various aspects of human life and the critical role it plays in the educational system of Nigeria, there is a persistent issue of poor academic achievement among students, which is reflected in low performance rates in examinations such as WAEC and NECO. The causes of this underachievement are complex and multifaceted, and while previous research has explored various student-related factors and societal influences, there remains a noticeable gap in the examination of teachers' reinforcement strategies and students' academic performance in Mathematics in Uyo Local Government Area.

Research Objective

1. To identify the types of reinforcement strategies employed by Mathematics teachers in secondary schools in Uyo Local Government Area.
2. To assess the effect of positive reinforcement strategies on students' academic performance

Research Question

1. What types of reinforcement strategies are employed by Mathematics teachers in secondary schools in Uyo Local Government Area?
2. How do positive reinforcement strategies affect students' academic performance in Mathematics?

Research Hypothesis

H₀₁: There is no significant difference in the types of reinforcement strategies employed by Mathematics teachers in secondary schools in Uyo Local Government Area.

H₀₂: There is no significant relationship between positive reinforcement strategies and students' academic performance in Mathematics.

Conceptual Review

Reinforcement Strategies

Reinforcement strategies are pivotal in shaping student behavior and enhancing academic performance, particularly in subjects like Mathematics. These strategies, rooted in behavioral psychology, involve the application of stimuli to increase the likelihood of a desired response (Aliyu et al., 2023; Oribhabor, 2020). In educational settings, reinforcement can be categorized into positive and negative forms, each with distinct implications for student learning and engagement.

Positive Reinforcement

Positive reinforcement involves presenting a rewarding stimulus following a desired behavior, thereby increasing the probability of its recurrence. In the classroom, this can manifest as verbal praise, tangible rewards, or additional privileges when students exhibit appropriate behaviors or achieve academic milestones. The efficacy of positive reinforcement in educational settings has been well-documented. For instance, a study by Aliyu et al. (2023) found that positive reinforcement techniques significantly improved students' motivation and performance in Mathematics among junior secondary school students in Kaduna State, Nigeria. Similarly, research by Smith (2017) demonstrated that positive reinforcement is a valuable tool for promoting desirable changes in student behavior, leading to increased academic performance.

Negative Reinforcement

Negative reinforcement involves the removal of an aversive stimulus following a desired behavior, thereby increasing the likelihood of that behavior's recurrence. In educational contexts, this might involve alleviating certain classroom restrictions when students demonstrate improved behavior or performance. However, the application of negative reinforcement in educational settings is less frequently documented in recent literature compared to positive reinforcement (Oribhabor, 2020).

Implementation in Educational Settings

Effective implementation of reinforcement strategies requires intentionality and diversity. Teachers should personalize feedback, offer constructive responses, and maintain consistency in their reinforcement methods. A study by Oribhabor (2020) emphasized the importance of activity-based teaching methods, which can be complemented by reinforcement strategies to improve students' achievement in Mathematics.

Academic Performance

Academic performance is a performance result that shows how much a person has achieved in relation to particular objectives that were the focus of activities in educational settings, particularly in school, college, and university. Academic performance is a student's apparent showing of understanding, concepts, skills, ideas, and knowledge. It describes how students manage their academic work and how they deal with or complete various assignments assigned to them by their lecturers throughout the course of an academic year or a set period of time.

Academic performance can be measured in the following ways. One of them is standardized tests which are designed to measure a student's knowledge and skills in a specific subject or area of study. It can also be measured through using continuous assessment or examination results and grades. LongJohn & Audu (2020) explain that these standard measurements of academic performance can be affected by elements such as test anxiety, environment, motivation, and emotions.

Academic performance is important for a variety of reasons. Firstly, it is often used as a measure of the effectiveness of education systems and schools. A crucial aspect of education is student academic performance (Anthony, 2018). It is regarded as the hub around which the entire educational system revolves. The academic performance of students decides whether an academic institution is successful or unsuccessful. High academic performance is typically seen as a sign of an effective education, and is often used as a measure of the quality of a school or education system.

Secondly, academic performance is strongly related to a person's future opportunities and success in life. Academic performance serves as a barometer for a student's success and future. It is crucial for creating the highest caliber graduates who will serve as the nation's leaders and labor force, as well as those who will be in charge of its economic and social advancement.

Theoretical Review

This study on teachers' reinforcement strategies and students' academic performance in Mathematics is grounded on several theoretical frameworks that provide insight into the dynamics of reinforcement, motivation, and learning outcomes. These theories include Skinner's Operant Conditioning Theory, Bandura's Social Learning Theory, and Vroom's Expectancy Theory.

1. Skinner's Operant Conditioning Theory

Skinner's Operant Conditioning Theory emphasizes the role of reinforcement in shaping behavior (Skinner, 2013). According to this theory, behaviors that are positively reinforced tend to be repeated, while those that are not reinforced or negatively reinforced are less likely to recur. Skinner categorized reinforcers into positive reinforcers, which introduce pleasant stimuli, and negative reinforcers, which remove unpleasant stimuli, both aiming to increase the likelihood of a behavior.

This theory is particularly relevant to this study as it underscores the importance of reinforcement in the classroom setting. Teachers' use of praise, tangible rewards, or corrective feedback to encourage desired behaviors aligns with Skinner's principles. The current study extends this theoretical foundation by exploring how such reinforcement strategies specifically impact students' performance in Mathematics in Uyo Local Government Area. Unlike Skinner's experiments conducted in controlled settings, this study applies these principles in a real-world educational context.

2. Bandura's Social Learning Theory

Bandura's Social Learning Theory posits that learning occurs through observation, imitation, and modeling (Bandura, 2017). Reinforcement plays a dual role in this process—not only does it strengthen learned behaviors, but it also influences the motivation to adopt such behaviors by observing others being rewarded or punished.

The theory's concept of vicarious reinforcement is pertinent to this study. Students may emulate peers who are positively reinforced for academic achievements in Mathematics. By investigating teachers' reinforcement strategies, this study contributes to understanding how modeling and observational learning can be harnessed to improve academic performance. While Bandura's theory emphasizes social contexts, the current study focuses on the structured classroom environment in secondary schools.

Methodology

The survey research design was adopted for this study. The population of the study comprised all Senior Secondary School (SSS) students and Mathematics teachers in public secondary schools in Uyo Local Government Area. A multistage sampling technique was used to select a sample size of 200 Senior Secondary School students and 20 Mathematics teachers was selected for the study. The primary instrument for data collection was a researcher-designed questionnaire titled "Enforcement Strategies and the Academic Performance of Students in Mathematics Questionnaire" (ESAPSMQ). The instrument was subjected to content and face validation by three experts from the Department of Educational Foundations, Guidance, and Counseling at the University of Uyo. The reliability of the instrument was established through a pilot study conducted in a public secondary school outside the selected sample in Uyo Local Government Area. Data collected were analyzed using both descriptive statistical methods. T-test, was employed to test the hypotheses at a 0.05 level of significance.

Results and Discussion

Research One: What types of reinforcement strategies are employed by Mathematics teachers in secondary schools in Uyo Local Government Area?

Table 1: Mean Scores for the types of reinforcement strategies employed by Mathematics teachers in secondary schools in Uyo Local Government Area

S/N	ITEMS	Students		Teachers	
		Mean (X)	Decision	Mean (X)	Decision
1	Mathematics teachers use verbal praise (e.g., “Good job!”) to encourage students.	3.44	Accepted	3.60	Accepted
2	Reward systems (e.g., gifts, certificates) are implemented to motivate high performance.	3.38	Accepted	3.50	Accepted
3	Constructive feedback is given to students to reinforce learning and correct mistakes.	3.42	Accepted	3.00	Accepted
4	Teachers employ non-verbal cues (e.g., smiles, nods) to reinforce positive behavior in class.	3.62	Accepted	3.60	Accepted
5	Teachers provide written commendations (e.g., notes, comments on homework) for good performance.	3.52	Accepted	3.40	Accepted

Source: Field Work (2024)

Table 1 shows the results of students and teachers responses on types of reinforcement strategies employed by Mathematics teachers in secondary schools in Uyo Local Government Area. All the five items harmonically obtained mean scores above 2.50. This is an indication that all the respondents accepted that; the items were the types of reinforcement strategies employed by Mathematics teachers in secondary schools in Uyo Local Government Area.

Research Two: How do positive reinforcement strategies affect students’ academic performance in Mathematics?

Table 2: Mean Scores for the effect of positive reinforcement strategies on students' academic performance in Mathematics

S/N	ITEMS	Students		Teachers	
		Mean (X)	Decision	Mean (X)	Decision
6	Verbal praise (e.g., "Well done") encourages students to put more effort into Mathematics tasks.	3.30	Accepted	3.70	Accepted
7	Rewarding students with tangible items (e.g., gifts, certificates) boosts their interest in learning.	3.48	Accepted	3.30	Accepted
8	Positive reinforcement increases students' confidence in tackling complex Mathematics problems.	3.30	Accepted	3.60	Accepted
9	Non-verbal reinforcement (e.g., smiles, claps, nods) creates a positive learning environment.	3.44	Accepted	3.40	Accepted
10	Positive reinforcement improves students' participation in Mathematics class activities.	3.10	Accepted	3.30	Accepted

Source: Field Work (2024)

Table 2 shows the results of the effect of positive reinforcement strategies on students' academic performance in Mathematics. All the affiliated items harmonically obtained mean scores above 2.50. This is an indication that all the respondents accepted that; the items were the effect of positive reinforcement strategies on students' academic performance in Mathematics.

Hypotheses Testing

Research Hypothesis One

There is no significant difference in the types of reinforcement strategies employed by Mathematics teachers in secondary schools in Uyo Local Government Area.

Table 3: t-test for the significant difference in the types of reinforcement strategies employed by Mathematics teachers in secondary schools in Uyo Local Government Area.

		N	\bar{x}	SD	Df	t ^{-cal}	t ^{-tab}	Sig	Dec
H₀₂	Students	40	3.46	0.12	38	53.865	1.833	0.000	Accepted
	Teachers	4	3.30	0.13					

Table 3, showed the result of the t-test for the **significant difference in the types of reinforcement strategies employed by Mathematics teachers in secondary schools in Uyo Local Government Area**. The result on table 4.10 showed that t^{-cal} (t=53.865, Sig=0.000, p≤0.05) is greater than t^{-tab} (1.833). This implies that, there was **significant difference in the types of reinforcement strategies employed by Mathematics teachers in secondary schools in Uyo Local Government Area**. Therefore the null hypothesis of there is no there is no **significant difference in the types of reinforcement strategies employed by Mathematics teachers in**

secondary schools in Uyo Local Government Area was rejected while the alternate hypothesis is accepted.

Research Hypothesis Two

There is no significant relationship between positive reinforcement strategies and students’ academic performance in Mathematics

Table 4: t-test for the significant relationship between positive reinforcement strategies and students’ academic performance in Mathematics

		N	\bar{x}	SD	Df	t ^{-cal}	t ^{-tab}	Sig	Dec
H₀₂	Students	40	3.46	0.12	38	59.399	1.833	0.000	Accepted
	Teachers	4	3.30	0.13					

Table 4, showed the result of the t-test for significant relationship between positive reinforcement strategies and students’ academic performance in Mathematics. The result on table 4.11 showed that t^{-cal} (t=59.399, Sig=0.000, p≤0.05) is greater than t^{-tab} (1.833). This implies that; there was significant relationship between positive reinforcement strategies and students’ academic performance in Mathematics. Therefore the null hypothesis of there is no significant relationship between positive reinforcement strategies and students’ academic performance in Mathematics was rejected while the alternate hypothesis is accepted.

Conclusion

Reinforcement strategies play a crucial role in enhancing students' academic performance in Mathematics by motivating learning and improving retention. Positive reinforcement, such as rewards and praise, boosts confidence and encourages consistent effort. Negative reinforcement, when applied correctly, helps students overcome fear and develop problem-solving skills. Immediate feedback strengthens understanding, while delayed reinforcement may reduce motivation. The current study was carried out on teachers’ reinforcement strategies and students’ academic performance in Mathematics in secondary schools, with a specific focus on Uyo Local Government Area, Akwa Ibom State, Nigeria. The study indicated that there was **significant difference in the types of reinforcement strategies employed by Mathematics teachers in secondary schools in Uyo Local Government Area.**

Recommendations

1. Teachers should use a mix of reinforcement strategies, including verbal praise, tangible rewards, immediate feedback, and non-verbal cues, to cater to diverse student needs and learning preferences.
2. Emphasis should be placed on positive reinforcement, as it has been shown to motivate students, enhance classroom participation, and improve overall academic performance in Mathematics.

REFERENCES

- Aliyu, A. S., Umar, H., & Muhammad, I. N. (2023). Influence of positive reinforcement technique on motivation and performance in Mathematics among junior secondary school students in Kaduna State, Nigeria. *Prestige Journal of Education*, 6(1), 74-82.
- Limene, T. (2018). *Examining factors influencing the academic performance of grade 12 learners in English language: A study of four schools in the Oshikoto region of Namibia*. [PhD Dissertation, the University of Fort Hare].
- Ohanyelu, C. N. (2021). Augmentation of students' academic performance in Mathematics through classroom management practices in Nigeria. *Journal Name*, 103-118.
- Organisation for Economic Co-operation and Development, OECD, (2024).
- Oribhabor, C. B. (2020). Evaluating the effect of activity-based method of teaching Mathematics on Nigerian secondary school students' achievement in Mathematics. *International Journal of Mathematics Trends and Technology*, 68(2), 51-59.
- Smith, J. (2017). Using positive reinforcement to increase student engagement in the classroom. *Journal of Educational Psychology*, 109(3), 321-334.
- Tella, A. (2008). Teacher variables as predictors of academic achievement of primary school pupils in Mathematics. *International Electronic Journal of Elementary Education*, 1(1), 17-23.
- Adetunde, I. (2009). Improving the teaching and learning of Mathematics in second-circle institutions in Ghana: Paper II. *New York Science Journal*, 2(5), 9-11