Teachers' Perspectives About the Effectiveness of Positive and Negative Reinforcement in Students' Mathematics Performance

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Abstract

The purpose of this research study is to investigate the teacher perspectives regarding the effectiveness of positive and negative reinforcement in enhancing student performance in mathematics. Mathematics is a vital and important subject and it has multifactor benefits such as problem-solving skills, enhances academic achievement, and opens doors to diverse applications in every field. Mathematics also fosters logical thinking, innovation, and decision-making abilities which make it an essential in various aspects of life. The study compared the outcomes of positive and negative reinforcement as perceived by mathematics teachers, and also identified the perceived strengths and weaknesses of strategies as reported by mathematics teachers by comparing the effectiveness of positive and negative reinforcement strategies. Through quantitative analysis of surveys conducted with a diverse sample of 200 mathematics' teachers of Islamabad. Statistical analysis of the survey data such as frequency, percentage, mean, standard ad deviation and t-value was calculated. Results indicated that there is a significant difference in the perceived outcomes and implications of positive and negative reinforcement on students' mathematical abilities, engagement, motivation, and overall learning experience as reported by mathematics teachers. At the end highlight the importance of understanding teachers' perspectives in shaping effective academic approaches to enhance student mathematics performance. To enhance students' performance in mathematics, it's imperative to balance positive and negative reinforcement strategies while tailoring approaches to individual student needs.

Keywords: Positive Reinforcement, Negative reinforcement, Teacher perception, Student performance

INTRODUCTION

In the educational framework, the triad of teacher, parent, and student forms a crucial bond, and the absence of any one element renders the triad

incomplete. The rule of teacher is indispensable in education, serving as knowledge providers, mentors, and role models. They create positive learning environments, offer individualized instruction, and provide assessment and feedback. Engaging with communities, they facilitate partnerships and advocate for student success. Continuous professional development ensures they remain effective in their roles. Ultimately, teachers contribute significantly to student academic achievement and personal growth. Learning is a multifaceted phenomenon that has been approached from various perspectives (Kusumawati, 2023). The significance of mathematics at the school level cannot be exaggerated. It serves as the cornerstone of various academic disciplines and real-world applications, problem-solving skills, logical reasoning abilities, and critical thinking capabilities. Furthermore, mathematics lays the foundation for higher education and careers in fields such as science, technology, engineering, and finance. The impact of both positive and negative reinforcement on student performance has been a topic of debate over the years. Positive reinforcement entails reinforcing a particular behaviour by offering a positive reward for its demonstration (Ruan, 2023) while negative reinforcement involves removing a negative practice that leads to embarrassment or harm by engaging in a specific behaviour. Positive reinforcement can range from a natural aspect of human courtesy to excessive coddling, whereas opinions on negative reinforcement may view it as a significant motivating factor or as a de-motivating influence.

This research seeks to investigate the perceptions and observations of mathematics teachers regarding the effectiveness of positive and negative reinforcement strategies in improving students' performance in mathematics education. The significance of the research study has the potential to contribute in the field of mathematics education and instructional practices by enhancing mathematics performance, informing instructional decision-making, tailoring instruction to local context and professional development of teachers.

The objectives of the study are as follows:

1. To investigate the perspectives of mathematics teachers, regarding the effectiveness of positive reinforcement on secondary students' mathematics performance.
2. To investigate the perspectives of mathematics teachers, regarding the effectiveness of negative reinforcement on secondary students' mathematics performance.
3. To compare the outcomes of positive and negative reinforcement as perceived by mathematics teachers, in terms of students' mathematical abilities, engagement, motivation, and overall learning experience.
4. To identify the perceived strengths and weaknesses of positive and negative reinforcement strategies as reported by mathematics teachers.

LITERATURE REVIEW

The literature review is about positive and negative reinforcement of teachers' perspective, and student performance. This discussion examines the perceptions and practices of mathematics teachers and how their attitudes and behavior may influence performance of mathematic students. This review comprises research regarding the theoretical understanding of mathematic subject.

Role of Reinforcement in Students' Mathematics Performance

Manzoor & Gill (2015) discuss the term "re-inforcement" gained prominence in the vocabulary of contributory conditioning, particularly championed by Skinner, a replacement for the traditional term "reward." The term "reward" had acquired a negative connotation due to its association with mentalism. Despite this, "reward" was considered more neutral compared to "reinforce." While a reward simply denotes a class of events that have an impact on the organism, "reinforcement" implies a specific effect, namely, strengthening.

According to the second definition, re-inforcement rewards that desired response occurs. Both the first and second definitions align with the common understanding of rewards, which is that they are positive outcomes received as a result of desirable behavior.

Skinner's another definition emphasizes that reinforcers must have a strengthening effect on behavior, which he considers the most scientifically relevant. In this definition, a reinforcer is any stimulus event which follows an operant response and consequently enhances the strength or likelihood of that response. Response rate typically serves as the primary measure of increased in response probability. The author categorizes reinforcers into two primary classes: positive and negative. Positive reinforcers elevate the likelihood of a response by being introduced into the situation, while negative reinforcers boost response probability by being taken away. Positive reinforcers encompass desired and sought-after stimuli, commonly referred to as rewards, such as food, praise, and money.

Reinforcement plays a pivotal role in shaping students' learning experiences throughout the teaching and learning process, with various definitions reflecting its multifaceted nature. According to Manzoor & Gill (2019), reinforcement is defined as an influence on behavior. Similarly, Sanjaya, as cited in Wahyudi, Mukhaiyar, & Refnaldi (2019), suggests that providing reinforcement can potentially have a positive impact on students' behavior. For instance, when students exhibit desirable attitudes in the classroom, such as actively participating in class activities or submitting homework punctually, the teacher may offer acknowledgment in the form of reinforcement. This expression of appreciation from the teacher fosters a sense of value in students, increasing the likelihood that they will continue to engage in such behaviors in the future.

Reinforcement serves as a critical catalyst for modifying students' behaviour within the classroom setting. Broadly categorized into positive and negative reinforcement, these mechanisms play distinct roles in shaping behavioural outcomes. As outlined by Santrock positive reinforcement entails an increase in the frequency of a response due to the introduction of a rewarding stimulus, while negative reinforcement involves the removal of an unpleasant stimulus, leading to a similar outcome. Simplistically put, positive reinforcement is often equated with rewards, whereas negative reinforcement is associated with punishment. Moreover, Otero and Haut (2019) assert that through the reinforcement provided by teachers, students acquire essential skills such as self-monitoring, time management, goal setting, and self-evaluation. This process of reinforcement not only encourages desirable behaviour but also empowers students to take ownership of their learning journey and develop critical self-regulatory abilities.

Furthermore, research has established a correlation between reinforcement techniques and students' academic achievement. Adibsereshki, Abkenar, Ashoori, and Mirzamani (2020) investigated the impact of employing reinforcements in the classroom on the academic performance of students with intellectual disabilities. Their findings revealed that both tangible reinforcement and social reinforcement significantly enhanced student achievement. However, inadequate implementation of reinforcement strategies by some teachers can lead to unfavourable classroom dynamics, resulting in student misbehaviour and decreased motivation. Consequently, such circumstances may potentially hinder students' academic progress.

The impacts of positive and negative reinforcement on various aspects of performance have been subject to extensive study and ongoing debate. Positive reinforcement typically involves reinforcing a particular behavior by offering a positive reward in response to that behavior. Conversely, negative reinforcement is often characterized by the removal of a negative experience that induces discomfort or harm through the execution of a specific behavior. While negative reinforcement may be perceived as a significant motivating factor, it can also be viewed as potentially discouraging. Similarly, opinions regarding positive reinforcement vary, ranging from considering it a natural expression of human decency to labeling it as unnecessary coddling (Greene, 2020).

Positive Reinforcement in Mathematics Education

Positive reinforcement stands out as a highly effective behavior management tool for teachers, wielding significant influence in shaping students' conduct. This technique serves as a compelling method for enhancing overall student behavior. Simply put, positive reinforcement can be described as "timely encouragement," which proves to be both gentle and impactful simultaneously (Eremie & Doueyi-Fiderikumo, 2021).

Additionally, as noted by Harmer (2019) when students engage in writing tasks, teachers play a crucial role in motivating, stimulating, and supporting them. In this context, positive reinforcement serves as a powerful tool for motivation, provocation, and support, influencing students' behaviour and emotional state positively. Ultimately, through the implementation of positive reinforcement strategies, writing achievement among students is likely to improve.

According to Gaffar, Atmowardoyo & Dollah (2022), positive reinforcement stands out as a recommended approach for teaching new behaviours, reinforcing appropriate behaviours, or mitigating inappropriate ones. Numerous researchers have demonstrated the effectiveness of employing simple positive reinforcement techniques, such as verbal praise, to assist teachers in enhancing academic performance and reducing disruptive classroom behaviour (Zebua, 2020). Thus, positive reinforcement emerges as a potent tool for managing and augmenting students' performance and behaviour. Interactions between teachers and students extend beyond the immediate classroom setting implying that effective reinforcement techniques employed by teachers can yield broader positive impacts. By utilizing positive reinforcement appropriately, teachers can potentially mitigate the frequency of negative interactions and reduce the likelihood of adverse long-term outcomes.

As highlighted by Pratiwi (2020), who asserts that the majority of students acknowledge the positive effects of positive reinforcement. These effects encompass improvements in students' attendance, grades, and confidence levels. Additionally, positive reinforcement is credited with bolstering student motivation and curbing inappropriate behaviour, leading students to anticipate enhanced performance in the classroom due to increased motivation.

Dweck and Molden, (2006) who emphasize the importance of fostering a growth mindset through positive reinforcement for sustained academic success in mathematics. The tension between short-term gains and potential long-term detriments unveils the intricate dynamics at play and necessitates a deeper exploration of alternative pedagogical approaches that prioritize positive reinforcement and motivational strategies in mathematics instruction.

Negative Reinforcement in Mathematics Education

Negative reinforcement, within the behavioral context, is a psychological concept focused on increasing the likelihood of a specific behavior by removing or avoiding an aversive stimulus. In the realm of education, this principle often manifests in classroom settings. For instance, a teacher might utilize negative reinforcement when a student completes assigned tasks to evade potential criticism or reprimand. The behavior of completing tasks is strengthened because it leads to the removal of an unpleasant consequence, making the student more likely to replicate the

behavior in similar situations. While negative reinforcement is distinct from punishment, as it aims to encourage rather than discourage behavior, its application in educational settings and its impact on students' learning experiences are areas of ongoing exploration and discussion within the fields of education and psychology. Negative reinforcement in the context of students' mathematics performance is a multifaceted concept with implications for both teaching practices and learner outcomes. Recent research by Raj, et al; (2023) delves into the intricate dynamics of negative reinforcement strategies employed by educators in mathematics classrooms. Their study not only examines the types of aversive stimuli often associated with poor performance but also scrutinizes the effectiveness of these strategies in fostering long-term improvements. Additionally, the work of Hertz-Palmor et al. (2023) provides insights into the psychological aspects of negative reinforcement, shedding light on the emotional impact on students subjected to such methods. Understanding the nuanced interplay between aversive stimuli, behavioral responses, and academic outcomes is crucial for educators seeking to create supportive and motivating learning environments. These studies collectively contribute to a growing body of literature that navigates the complexities of negative reinforcement in students' mathematics education, offering valuable insights for educators, researchers, and policymakers alike.

METHODOLOGY

In this research study, a quantitative research approach was used to find out the teachers' perspectives about the effectiveness of positive and negative reinforcement in students' mathematics performance. As the research study is quantitative, therefore, a descriptive survey design was used for the study. In the descriptive design, the researcher sends out a survey to a group of people or the whole populations to show what people think, do, or are like. In the majority of cases, questionnaires are used to get quantitative, numbered data about how people answer questions. Questionnaire was used to gather information from a specific sample of mathematics teachers in secondary schools located in sector G-6, G-7, G-9, G-10, I-10, F-6, F-7 and I-9, Islamabad. The population of the study consists of mathematic teachers from 44 public and 90 private schools of the selected sectors of Islamabad. Total number of mathematics teachers in the population is 318. The source of the data is from the office of Federal Directorate of Education (FDE) and Private Educational Institutions Regulatory Authority (PEIRA), Islamabad. The research study was conducted in 2024.

Simple Random Sampling technique was used for collection of data from sample. The sample size of the study consists of Two hundred mathematic teachers from the public and private schools of designated areas of Islamabad. Self structured questionnaire was used to collect data. Before

the collection of data, a pilot testing was conducted to check the reliability and validity of the instruments. For the piloting testing, 20 teachers were selected and prescribed questionnaires were distributed to them. The identified errors and faults in the questionnaire were removed and reliability of the questionnaires was checked by Cronbach's Alpha using SPSS version 26.0. The reliability of the questionnaire is 0.77 whereas the acceptable level is 0.6 to 0.9. The validity of the instruments (questionnaire) was assessed by two expert's teachers from the Education Department of University of Peshawar and Education Department FDE, Islamabad. Two methods were used to collect the data, online data collection via Google form and physical filling the prescribed form. Frequency, percentages mean and t-test was applied for analysis.

RESULTS

Table 1 Analysis on Positive Reinforcement

Option	Frequency	Percentage
Always	95	49%
often	54	26%
sometime	46	23%
almost never	3	2%
never	1	0%

The average analysis of positive reinforcement, having Always = 49 %, Often= 26 %, Sometime = 23 %. The result indicated that most of the teachers use Positive Reinforcement to enhance student mathematics performance.

Table 2 Analysis on Negative Reinforcement

Option	Frequency	Percentage
Always	17	9%
often	37	19%
sometime	45	23%
almost never	33	16%
never	67	34%

The average analysis of, Negative Reinforcement the average Never =33 %, Sometime=23 %, Almost never=16 % and often =16%. The result indicated that very few teachers use Negative Reinforcement to enhance student mathematics performance.

Table 3 Analysis on overall learning experience

Option	Frequency	Percentage
Strongly Agree	53	27%

Agree	66	33%
Neutral	27	14%
Disagree	39	20%
Strongly disagree	15	8%

The analysis of overall learning experience, results indicated that the positive reinforcement improve students' mathematical abilities, engagement, motivation, and overall learning experience as compare to negative reinforcement .

Table 4 Average on Overall learning experience

Option	Frequency	Percentage
Strongly Agree	57	29%
Agree	82	41%
Neutral	33	17%
Disagree	21	10%
Strongly disagree	8	4%

The average analysis of this section as shown in the above table result indicated that Positive Reinforcement strategies has a great strength on the same side the result further stated the Negative Reinforcement strategies shows weakness.

Table 5 Difference of Perceived Effectiveness

Perceived Effectiveness	Types of reinforcement	N	Mean	Std. Deviation	t-test	P-value
	Positive reinforcement	113	4.72	0.45	1.20	0.020
	Negative reinforcement	87	4.64	0.48		

Data presented in the above table shows the difference between Positive reinforcement and negative reinforcement of teachers toward Perceived Effectiveness, a total of 113 teachers showed positive with a mean of 4.71, a standard deviation of 0.45, however, 87 teachers showed negative with a mean of 4.64, with a standard deviation of 0.48. Moreover, t-test value is 1.20 with a P-value is 0.020 which is less than the significant value i.e., 0.05, the result indicated that there is a significant difference in the perceived effectiveness of positive and

negative reinforcement on secondary students' mathematics performance as reported by mathematics teachers, hence we reject our null hypothesis.

Table 6 Perceived outcomes and implications

perceived outcome and implications	Types of reinforcement	N	Mean	Std. Deviation	t-test	P-value
	Positive reinforcement	113	2.85	.97	2.83	0.000
	Negative reinforcement	87	3.28	1.22		

Data presented in the above table shows the difference between Positive reinforcement and negative reinforcement of teachers toward perceived outcomes and implications, a total of 113 teachers showed positive with a mean of 2.85, a standard deviation of 0.97, however, 87 teachers showed negative with a mean of 3.28, with a standard deviation of 1.22. Moreover t-test value is 2.83 with a P-value is 0.0 which is less than the significant value i.e., 0.05, the result indicated that there is a significant difference in the perceived outcomes and implications of positive and negative reinforcement on students' mathematical abilities, engagement, motivation, and overall learning experience as reported by mathematics teachers, hence we reject our null hypothesis.

DISCUSSION

The majority of teachers appear to employ positive reinforcement strategies, such as verbal praise and rewards, to acknowledge and encourage students' performance in mathematics. This suggests a widespread recognition among educators of the motivational benefits of positive reinforcement in fostering a positive learning environment and boosting student confidence. Furthermore, the study reveals varying frequencies in the use of reinforcement strategies, with some teachers consistently providing rewards for desired behaviors, while others do so occasionally. This highlights the importance of understanding individual teacher practices and preferences in implementing reinforcement techniques effectively. Moreover, the findings suggest that positive reinforcement techniques are generally perceived to have a positive impact on students' mathematical abilities, engagement, motivation, and overall learning experience. This underscores the potential of positive reinforcement to enhance student performance and create a supportive learning atmosphere in mathematics classrooms. Conversely, the effectiveness of negative reinforcement strategies appears to be more contested among educators. While some teachers may employ consequences for poor performance as a means of addressing behavioral issues and promoting accountability, others may question the efficacy of such approaches in improving student outcomes.

To enhance students' performance in mathematics, it's imperative to balance positive and negative reinforcement strategies while tailoring approaches to individual student needs. Providing professional development opportunities for teachers to deepen their understanding and implementation of these strategies is essential.

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