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Teaching Strategies that Inspire: Examining the Impact of Instructional Methods on Students' Motivation and Mathematics Achievement

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Abstract

Mathematics is a fundamental subject that supports logical reasoning, problem-solving, and it provides analytical skills which is essential for all students in academic and professional development. The main objectives of this study were to identify the perceptions of students about the impact of instructional methods on students' motivation and mathematics achievement in Nepal and to determine the relationship between instructional methods, students' motivation and mathematics achievement. Expected value theory and Self-determination theories were taken as the theoretical base. In this study, only a quantitative approach was used, and 196 students were used as a sample, which was selected using a stratified random sampling method. Likert 5-point scale questionnaire was used to examine the perceptions of students in different headings, and the validity of items was tested by the expert judgement method, and the reliability was tested using Cronbach's alpha value. The findings show that the students had positive perceptions about all three variables: instructional methods, motivation in mathematics, and mathematics achievement. Also, there was a strong positive correlation between the variables which shows that effective and engaging teaching methods increase a higher level of motivation of students in learning mathematics, and to achieve good achievement in mathematics. Therefore, the teacher must prioritize different teaching methods which helps students in psychological engagement and academic success in mathematics.

Keywords: Inspire, teaching strategies, motivation, mathematics achievement, engaging

Introduction

Mathematics is a fundamental subject that supports logical reasoning, problem-solving, and it provides analytical skills that are essential for all students in academic and professional development. In almost all countries, including Nepal, mathematics is given priority in the national curriculum from primary to secondary level. However, in Nepal, students' achievement in mathematics and motivation towards mathematics are still low. The results obtained from the National Examination Board (NEB) and the findings of various research studies show that mathematics is still a challenging subject for Nepali students. Some students are still unable to achieve the specified achievement standards. This shows that the effectiveness of the teaching methods used in classroom teaching has been questioned, which encourages students to lead their learning experience in a positive direction.

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We understand that the various strategies and approaches that teachers use in classroom teaching are teaching methods. In the context of Nepal, emphasis has been placed on the use of traditional lecture-based methods for decades, which give more priority to rote memorization. Student-centered teaching methods seem to dominate this method. Although this method provides teachers with ease in completing the prescribed curriculum on time. It creates obstacles in students' active participation in learning, critical thinking, and conceptual understanding of the subject. However, student-centered methods such as project-based learning, problem-based learning, and technology-assisted methods help in developing students' skills of engagement, collaboration, and exploration in learning (Fisher et al., 2020; Murtiyasa & Karomah, 2020; Vlasenko et al., 2020; Zen et al., 2022). Various international research studies have also emphasized that motivation helps students in meaningful and logical learning (Kho et al., 2024; Murtiyasa & Karomah, 2020; Toles, 2010). It creates motivation in mathematics learning. The mathematical achievement of students who are motivated towards mathematics has been seen to be positive (Bishara, 2018). Various theories, such as expectancy value and self-determination, have also emphasized that motivation provides positive vibes in learning. In countries like ours, where there are many students in a class, limited resources, and exam-centered teaching, it has not been possible to develop a positive attitude in students towards mathematics learning. Due to which students see mathematics as a subject that must be passed in the exam rather than as a logical subject. Research conducted in various countries has also shown that there is a positive relationship between student-centered teaching methods and students' mathematical achievement (Vlasenko et al., 2020). However, in the context of Nepal, there seems to be less research on this subject. In addition, those that do exist seem to focus more on teaching problems. However, there seems to be less research on which teaching methods help students gain positive motivation in learning mathematics. Therefore, the main objectives of this research are to find out what effect the use of different teaching methods has on students' motivation and mathematics achievement.

Objective of the Study

This study was conducted under the following objectives:

- To identify the perceptions of students about the impact of instructional methods on students' motivation and mathematics achievement in Nepal.
- To determine the relationship between instructional methods, students' motivation and mathematics achievement.

Review of Related Literature

In this section, different empirical and theoretical literature which were related to this study were discussed.

Empirical Review

Conceptual teaching positively increases students' mathematics achievement, but process-oriented teaching strategies create a negative environment in learning mathematics (Yu & Singh, 2018), and thus teacher support increases students' motivation in mathematics, and helps to achieve good mathematics achievement (Wong & Wong, 2021). Similarly, Purnami et al. 2018 found that the team-accelerated instruction motivated students in learning mathematics, and students got better

achievement in mathematics. The motivation, learning style, and discipline of learning always have a positive relation and significantly affect students' achievement in academic achievement (Chik & Abdullah, 2018). Self-image, motivation, and achievement of students in active teaching and learning classes to learn mathematics is higher than in traditional methods using classroom methods (Bishara, 2018). Motivational styles and instructional practices of teachers positively correlated with students' learning in mathematics, and teachers may regularly motivate and utilize instructional practices that improve the achievement of students in mathematics (Murtiyasa & Karomah, 2020). To increase the interest of higher students in mathematics directly dependent on their level of motivation, and different student-centered teaching strategies raise students' motivation while studying mathematics (Vlasenko et al., 2020). ICT-based teaching strategy in the classroom engages and motivates students in mathematics learning, and result shows that the achievement of students taught through ICT has better achievement than those who are taught through traditional methods (Zen et al., 2022).

Theoretical Review

The selection of Instructional methods has a significant influence on students' mathematics achievement, and it depends on academic motivation. The **Expected Value Theory (EVT)** focused on autonomy-supportive and student-centered pedagogies. (Wigfield & Eccles, 2000) Like inquiry-based learning and it also focuses on contextualized problem-solving approach in learning, which positively influences students' expectancy for success (self-efficacy). These methods enhance task value by explicitly demonstrating utility value and fostering intrinsic value. Conversely, the didactic or controlling instructional environment in mathematics class can reduce both expectancy and value perceptions, and it creates motivational deficits and math anxiety. (Weber et al., 2020). Thus, Instructional methods impact mathematics achievement by regulating students' motivation through the following two core mechanisms of Expected Value Theory: Students' belief in their ability to succeed and the personal importance they assign to the task. Hence, the Expected Value Theory provides a theoretical base in this study.

The **Self- Self-Determination Theory** also believes that the instructional methods profoundly influence motivation (Vallerand et al., 2008) and it helps to achieve good mathematics achievement. Effective teaching methods increase students' satisfaction, and ineffective teaching methods frustrate students and do not fulfill basic psychological needs. Autonomy-oriented or self-directed teaching methods promote competence, relatedness, and provide intrinsic motivation to the students in mathematics learning. The autonomy-oriented motivation leads to greater effort and deeper conceptual understanding. (León et al., 2015) and it helps in higher mathematics achievement. This theory also focused on student-centered teaching methods for more positive motivation and better mathematics achievement.

Methodology

This study used only a quantitative approach to find the students' perceptions. The population of this study was all grade ten students of Madhyapur Thimi Municipality of Bhaktapur District. Using the stratified random sampling (based on school type, location, and number of students)

design two private and two public schools were selected, and 196 (107 boys and 89 girls) students in total were present at study time, and all the students were selected as the sample in this study. A 5-point Likert scale questionnaire (Strongly Disagree = 1 to Strongly Agree = 5) with three sections (each with five questions), instructional methods, students' motivation, and mathematics achievement were used as a data collection tool. To make the questionnaire, the researcher had taken ideas from previous studies and had also taken ideas from ChatGPT. For testing the validity of items, the researcher used the expert judgment method. The validity of the items in the questionnaire was tested by three teachers, of whom two were teaching mathematics (one from school level and another from university level) and one was teaching an instructional methods-related course at the university level. Similarly, the reliability of test items were tested using Cronbach's alpha value and the value of alpha was calculated using SPSS version 26 and found 0.79 and it shows that there was high degree of positive correlation and if the value of alpha is greater than 0.70 then the test items is acceptable and hence the items in questionnaire was reliable and used to collect the data in this study. Researchers obtain permission from the school's head teacher and mathematics teacher of each school, and informed consent from participants. After getting the permission, the researcher administered the Likert-scale questionnaire to selected students during class hours. The collected data were analyzed using both descriptive and inferential statistics, and the values were calculated using SPSS version 26 software. In descriptive statistics, researchers used mean, standard deviation, and frequency distribution of responses, and similarly in inferential statistics, the Pearson correlation between instructional methods, motivation, and mathematics achievement was used.

Results and Discussion

The results of the data through 196 Grade Ten students are presented in the following phases: (a) descriptive characteristics of the study, (b) descriptive statistical analysis of all items in the questionnaire, and correlation analysis between instructional methods, motivation, and mathematics achievement.

Table 1

Descriptive Characteristics of the Study

Variable	Category	Frequency	Percentage
Gender	Male	107	54.59
	Female	89	45.41
School Type	Public	102	52.04
	Private	94	47.96

Table 1 presents the demographic characteristics of the participants in this study in terms of gender and school type. 196 students participated in this study, in which 107 (54.59%) were male and 89 (45.41%) were female. In comparison, the sample had a slightly higher representation of male students compared to female students. Similarly, 102 (52.04%) students were from public schools, and 94(47.96%) students were from private schools. This shows that both private and public school students were almost equally represented in this study, with a marginally higher proportion of participants from public schools. This shows that the number of students in both

groups is approximately equal, both in terms of school type and gender, making it easy to generalize the findings from the study across both types of schools and between both genders.

Table 2

Descriptive Statistics of Different Constructs

Constructs	Items	Mean	SD	Cronbach's
Instructional Methods	5	4.20	0.76	0.82
Motivation	5	**4.38**	0.71	0.77
Mathematics Achievement	5	4.02	0.77	0.79

Table 2 shows descriptive statistics and reliability coefficients of three main constructs: instructional methods, motivation, and mathematics achievement. The mean and standard deviation scores of items related to instructional methods were 4.20 and 0.76, respectively. Similarly, the mean and standard deviation of items related to motivation were 4.38 and 0.71, respectively. Also, the mean and standard deviation of items related to mathematics achievement were 4.02 and 0.77, respectively. The mean values of all three constructs were relatively high, ranging from 4.02 to 4.38, which indicates that respondents generally expressed favorable perceptions towards the statements related to the three items. Similarly, the standard deviations of all constructs fall between 0.71 and 0.77 which indicates that there was a moderate level of variability among the responses.

The internal consistency reliability of each construct was measured by Cronbach's alpha (α). The respective values of in constructs were 0.82, 0.77, and 0.79. The ' instructional methods showed the highest reliability, and this indicates a strong level of internal consistency among the items. Similarly, the items in motivation and mathematics achievement also demonstrated good reliability.

Thus, the descriptive results indicate that participants had positive attitudes towards instructional methods, motivation, and mathematics achievements. Also, the low standard deviation and high Cronbach's alpha coefficients confirm that the measurement instruments were both consistent and reliable.

Table 3

Descriptive Statistics of Items on Instructional Methods

Item code	Statements	Mean	SD	Min	Max
IM1	Group work and classroom discussion help me to understand mathematics clearly.	**4.35**	0.78	2	5
IM2	My mathematics teacher explains the mathematics problem clearly.	4.21	1.08	1	5
IM3	My teacher teaches mathematics by connecting with real-life problems.	3.98	0.73	1	5
IM4	My teacher provides regular feedback, and it helps me to correct my mistakes.	4.32	1.05	1	5
IM5	I feel excited when my teacher uses different teaching techniques in mathematics class.	4.16	1.12	2	5

From Table 2, we saw that all items had relatively high mean scores ranging from 3.98 to 4.35 which suggests that the perceptions of students about all items in instructional methods were positive. The highest mean score (4.35) is observed for item IM1 ("*Group work and classroom discussion helps me to understand mathematics clearly")* and it shows that a collaborative and interactive learning environment is beneficial in mathematics learning. Similarly, item IM4 *("My teacher provides regular feedback and it helps me to correct my mistakes")* also shows a high mean score (4.32), and it shows that regular feedback helps to improve students' mistakes frequently. The mean score (3.98) of item IM3 *("My teacher teaches mathematics by connecting with real-life problems")* shows the lowest mean score in comparison to other items.

The standard deviation values of items were between 0.73 and 1.12. The item IM3 *("My teacher teaches mathematics by connecting with real-life problems")* has the lowest SD (0.73), and it shows that there were the highest consistency responses at that item. Similarly, item IM5 *("I feel excited when my teacher used different teaching techniques in mathematics class")* had the highest SD (1.12), and it shows that there was the greatest variability or opinion difference among participants at that items.

Table 4

Descriptive Statistics of Items on Motivation in Mathematics

Item code	Statements	Mean	SD	Min	Max
MM1	I believe that mathematics is useful in my life.	4.43	0.67	4	5
MM2	I like to solve mathematical problems at home and school.	4.39	0.73	3	5
MM3	I am working hard to improve my mathematics skills.	4.32	0.78	3	5
MM4	I feel proud when I understand complex mathematical problems.	**4.47**	0.72	3	5
MM5	I am learning math not only to get marks but also to gain concepts for further study.	4.29	0.82	2	5

From Table 4, we saw that there was a strong positive motivational tendency among the respondents for all items because the mean scores (Between 4.29 to 4.47) of all items were greater than the average mean score in the Likert 5-point scale. The mean score of item MM4 *("I feel proud when I understand complex mathematical problems")* was 4.47 which is higher than other items, and it shows that the students are positively motivated when they understand complex mathematical problems. Also, the mean score of item MM5 *("I am learning math not only for getting marks but also to gain concepts for further study")* was 4.29, which is lower than the mean scores of other items. While still a high positive score but its position at the bottom of the list suggests that students are slightly less motivated for further learning in comparison to utility, pride, and solving complex problems.

The standard deviation of items was between 0. 67 to 0. 82. The standard deviation of item MM1 *("I believe that mathematics is useful in my life")* was 0.67, which was smaller than the standard deviations of other items, showing that there was a high degree of consensus around this specific motivational factor. Similarly, the standard deviation of item MM5 was 0.82, which was

greater than the standard deviation of other items, showing that there was slightly more variation in opinion among the respondents.

Table 5

Descriptive Statistics of Items in Mathematics Achievement

Item Code	Statements	Mean	SD	Min	Max
MA1	I can solve most of the problems in class given by the teacher.	3.87	1.02	2	5
MA2	I remember mathematical formulas and concepts easily.	3.78	1.04	2	5
MA3	My score in math is improving nowadays.	4.14	0.76	3	5
MA4	I can connect previous math concepts with my new topics.	3.99	0.98	3	5
MA5	Different instructional methods used by my teacher helped me to achieve better results in math.	4.23	0.67	3	5

From Table 5, we saw that the item MA5 *("Different instructional methods used by my teacher help me to achieve better results in math")* had the highest mean score (4.23) in comparison with other items. It shows that students want a variety of teaching methods in the mathematics classroom from teachers to get better results in mathematics. Also, this item had the lowest standard deviation (0.67) in comparison with other items also shows that there was a high degree of consensus among the participants regarding this positive perception.

Similarly, the item MA2 *("I remember mathematical formulas and concepts easily")* had the lowest mean score (3.78) in comparison with other items, and shows that most of the students were not remembering mathematical formulas and concepts easily. Also, this item had the greatest standard deviation (1.04) in comparison with other items implies that there was slightly more variation in response to this item among the respondents.

Table 6

Pearson's Correlation Matrix between Constraints

Variable	IM	MM	MA
IM	1.00	0.79	0.73
MM	0.79	1.00	0.81
MA	0.73	0.81	1.00

***Note**:* All correlations are significant at $p < 0.001$.

Table 6 shows that the correlation coefficient for every possible pair of variables or constraints measures the strength and direction of the linear relationship between the variables. If the values of correlation coefficients are close to +1, then the variables have a strong relationship, and if the values of r (correlation coefficients between two variables) are close to 0, then the variables have a weak relationship. The matrix shows a statistically significant positive correlation among all three

variables. The correlation coefficient between instructional methods and motivation was 0.79 which shows that there was a strong positive correlation, and it suggests that effective instructional methods increase students' motivation in mathematics. Also, the correlation coefficient between instructional methods and mathematics achievement was 0.73, which shows a strong positive correlation between them, and it indicates that better instructional methods are associated with a higher level of mathematics achievement. Similarly, the correlation coefficient between motivation and mathematics achievement was 0.81 which shows a very strong (strongest) positive relationship between motivation in mathematics and mathematics achievement, and it indicates that highly motivated students tend to achieve significantly higher mathematics achievement.

Conclusion

The descriptive statistics and reliability finding shows that students have positive perceptions across the three variables: Instructional methods, Motivation in mathematics, and Mathematics achievement. Students reported high mean scores in instructional methods with 4.20, motivation in mathematics with 4.38, and mathematics achievement with 4.02 on a 5-point Likert scale. Also, the correlation coefficient between the three variables was strongly positive. The study successfully established a significant and positive relationship between the instructional methods used by teachers, the level of students' motivation, and overall mathematics achievement. Also, the findings show that all the factors are not isolated but are deeply interconnected for successful learning outcomes in mathematics. Also, these findings show that effective and engaging teaching methods increase higher levels of motivation of students in learning mathematics, and to achieve good achievement in mathematics. Therefore, the teacher must prioritize different teaching methods which helps students in psychological engagement and academic success in mathematics.

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