



Students' Motivation in Learning Mathematics: Dimensions and Difficulties

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Abstract

This article examines the diverse motivational factors that influence students' decisions to study mathematics. Through analysis of student responses and relevant literature, six key motivational dimensions are identified: career aspirations, utility value, personal interest, family influence, social value, and overcoming challenges. The article presents a theoretical framework for understanding these motivations and discusses implications for mathematics education practice. A comprehensive research methodology, including a Focus Group Discussion (FGD), was applied to find different motivational factors of students. The findings suggest that different dimensions of motivation help to enhance student engagement in mathematics and improve educational outcomes.

Keywords: Career aspirations, family influence, personal interest, social value, utility value

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Introduction

Mathematics education is important in the curriculum of schools and university levels around the globe due to its vital role in development, logical reasoning, enhancing problem-solving abilities, and facilitating applications across various disciplines (Schoenfeld, 2016). While its significance is extensively acknowledged, student motivation toward mathematics differs greatly, affecting persistence, achievement, and the decision to study the subject in higher education (Middleton & Spanias, 1999). Considering the students' priority to study mathematics can offer valuable information, which influences teaching practices, curriculum design, and educational policy (Watt et al., 2012). This research article mainly focuses on various motivational factors that affect students' choices to study mathematics. Theoretical frameworks from educational psychology support the students' feedback. The researchers were trying to identify the factors interrelated to motivational dimensions that drive student enrollment in the college and university levels with major mathematics. By exploring these factors, educators can create focused strategies to boost student motivation and potentially enhance participation in mathematics education. There was a context-specific, multi-dimensional, and qualitatively rich investigation into the Nepali students' motivation towards the mathematics

subject. The previous studies have insufficiently addressed the issues of mathematics learning by connecting the local cultural, socioeconomic status, and institutional factors, which are globally validated. In this context, it is necessary to identify the factors of students' selection of the mathematics subject. For this purpose, the following objectives have been set.

1. To explore the factors associated with the motivation of the students to study the mathematics subject.
2. To explore the students' perception of the choice of the mathematics subject.

Theoretical Perspective and Existing Literature

Several theoretical stances support student motivation in mathematics instruction. Self-Determination Theory distinguishes between extrinsic motivation (performing for results) and intrinsic motivation (engaged for satisfaction), both of which are present in students' motivations for learning mathematics (Ryan & Deci, 2000). The utility and career components of mathematics motivation are explained by the Expectancy-Value Theory (Wigfield & Eccles, 2000), which shows that students' decisions are impacted by their success expectations and the task's subjective value.

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In this line of research on overcoming obstacles and the influence of family, the Social Cognitive Theory (Bandura, 1986) emphasizes the importance of social interaction and self-efficacy beliefs in academic motivation. Additionally, the Achievement Goal Theory (Elliot & McGregor, 2001) provides important information on how students' objectives influence learning mathematics. Numerous significant theoretical frameworks guide research on mathematical motivation and combine a comprehensive knowledge of the variables influencing students' involvement with mathematics learning. According to the expectation-value theory (Wigfield & Eccles, 2000), students' subjective value includes elements of utility, interest, attainment, cost, and their expectations of success, which have an impact on their decisions, perseverance, and performance in mathematics.

Self-determination theory (Ryan & Deci, 2000) highlights that autonomy, competence, and relatedness are psychological needs necessary for optimal motivation. It makes a distinction between intrinsic motivation (doing mathematics for intrinsic satisfaction) and several types of extrinsic motivation. Through cognitive, motivational, affective, and selection processes, social cognitive theory (Bandura, 1997) emphasizes self-efficacy, students' ideas about their ability to learn mathematics as a key factor determining effort, persistence, and accomplishment. The idea of achievement goals (Elliot & McGregor, 2001) looks at how motivation patterns are influenced by students' reasons for participating in mathematics (mastery goals that emphasize learning versus performance goals that emphasize showcasing abilities). While mindset theory (Dweck, 2006) contrasts fixed mindsets (thinking mathematical ability is innate) with growth mindsets (thinking it can be developed), interest development theories (Hidi & Renninger, 2006) describe how situational interest in mathematics can develop into well-developed individual interest through four phases. According to these complementary frameworks, students' ideas, values, aspirations, and experiences within particular social and cultural settings all have an impact on mathematical motivation, which is a complex, multifaceted construct.

Methods and Procedures

This study employed a qualitative research method with an exploratory design. This section deals with the data source and collection procedures, and the analysis of data with the different theoretical and empirical evidences.

Data Sources

The initial analysis draws from reflective responses of eight students explaining their motivations for studying mathematics with their stories in narrative form. These responses were collected through open-ended FGD and provide authentic insights into students' decision-making processes. While limited in scope, these responses served as a foundation for identifying preliminary motivational themes that informed the subsequent development of a comprehensive research.

Tools for Data Collection

The FGD guidelines were used to explore the students' motivation. Students studying in grade XI and grade XII in one of the community campuses in Sindhuli district were taken as participants for the focus group discussion. Altogether, eight students participated in the discussion. The researcher asked the questions for each of the students and explored their reasons for selecting the mathematics subject in their study. Opportunities were provided to each student to explore their views and interests, including their difficulties and future plans to study the mathematics subject. The FGD was recorded in the Nepali language, and later translated into English and analyzed.

The FGD guidelines based on their preferences, challenges, and motivation towards the mathematics subject were developed by considering the differences in motivational dimensions of students. The open-ended questions were constructed to measure the open views of students related to each of the motivational factors and to capture the qualitative information from the students. This explorative approach provides the experiences of students as a form of story. Motivational patterns and a deeper understanding of individual perspectives were collected through FGD gathering in the campus's meeting hall. Students' responses revealed and analyzed in six primary motivational themes to study mathematics. The open-ended questions were validated by using expert judgments of two university professors, two mathematics teachers (one from community and one from institutional schools) and two administrators (coordinator). An assistant campus chief of one of the constituent campus of Tribhuvan University was also an experts. The suggestions were collected from the experts and made clear about its ambiguity in languages. The suggestions provided by them were incorporated in the open ended questions and finalized it. The five themes for the analysis were presented in the following Figure 1.

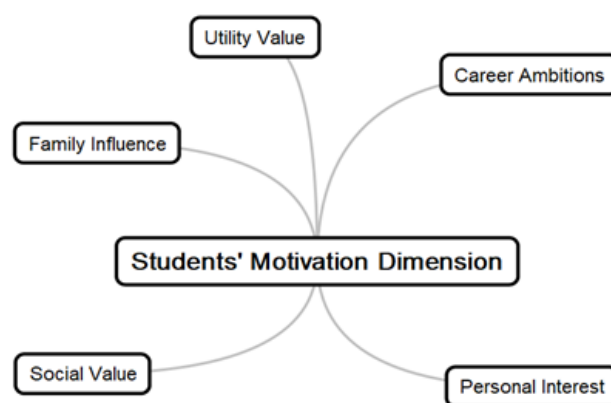


Figure 1: Themes for Students Motivation Dimension

Data Analysis and Interpretation

The collected information was thematically analyzed and employed to identify repeated patterns and themes in the responses of students. This qualitative analytical method allowed for the identification of implicit and explicit ideas

within the data (Braun & Clarke, 2006). Through iterative coding and categorization, six distinct motivational dimensions emerged.

Results

This section explores the different findings based on the collected information at the time of focus group discussion (FGD). The FGD was held on the round table management system in the campus meeting hall. Students studying in grades XI and XII were present at the time of FGD. The different dimensions of motivational factors for the selection of the mathematics subject were analyzed on the basis of five themes. One of the main themes for the motivation to study the mathematics subject was the career aspiration dimension.

Career Aspirations Dimension

Since students understand the value and necessity of mathematics in entering desirable professional disciplines, students' job goals frequently serve as a driving force behind their mathematics education. Expectancy-value theory (Wigfield & Eccles, 2000) states that when students believe mathematics, it will be useful for their future, they will be more engaged with it. Wang and Degol (2013) discovered that the usefulness of mathematics for their professional goals has a huge impact on college students who choose STEM disciplines. In a similar vein, Watt et al. (2012) used a longitudinal study to show that the course selection and determination of adolescents in advanced mathematics were predicted by their career ambitions linked to mathematics.

One of the strongest motivating factor is the belief on mathematics that is necessary for high-status professions in engineering, medicine, finance, and technology (Murayama et al., 2013). Additionally, Lauermann et al. (2017) showed that students exhibit higher levels of engagement and accomplishment in mathematics learning when they see a clear connection between mathematical competencies and their professional goals. With students stating plans to teach mathematics or realizing the value of mathematical skills for their chosen job pathways, career-related incentives appeared as a key component. This result is consistent with the study by Watt et al. (2012), who found that students' educational choices linked to mathematics were significantly influenced by career utility. In this context, one of the students studying in Grade XII expressed her views:

"I study mathematics to be a good teacher in the future" (S₂), while another mentioned, "I am studying mathematics to see its scope in the future (S8). When I was studying in grade IX, we had a teacher who taught us mathematics, many people, including students and teachers, believe his opinions on every topic. By seeing this, I was motivated to be a good mathematics teacher and teach the mathematics subject in the community school."

From the analysis of these types of views of students, it

was clear that the career dimension reflects extrinsic motivation focused on long-term objectives by highlighting the instrumental importance that motivates on mathematics as a means of achieving professional prospects (Murayama et al., 2013).

Utility Value of Mathematics

One of the principal motivators for students is the perceived utility value of mathematics, or how applicable it is to real-world situations and future events. According to Eccles and Wigfield (2020), students' motivation and perseverance significantly rise when they see how mathematical knowledge can be applied in real-world situations. Hulleman et al. (2010) conducted empirical research that showed the interventions helped students relate mathematical concepts and material to their everyday life, improved their interest and performance, especially for students who had lower expectations for success. Applications of mathematics in consumer decision-making, personal finance, and spatial reasoning offer tangible benefits that speak to students' pressing issues (Harackiewicz et al., 2016). Notably, Gaspard et al. (2015) discovered that secondary school students' enthusiasm for mathematics increased after receiving brief utility-value treatments that raised knowledge of the subject's application to everyday life.

This utility-focused strategy creates motivation that goes beyond academic requirements by connecting abstract mathematical principles with real-world advantages. Students acknowledged that learning mathematics helped them understand other courses and build skills that they could apply in different contexts. This view of utility value is in line with research by Hulleman et al. (2010), which showed that interest and performance are raised when one feels that mathematics is relevant to one's life. Highlighting the importance of the mathematics subject, two students, S₃ and S₅, expressed their views clearly:

"I have chosen mathematics because it is useful to study every subject" (S₃). She has also highlighted the interrelation between mathematics and the computer subject. In the same context, she expressed her views as 'I have chosen computer science and mathematics in grade XI and XII as major subjects, because they are interrelated to each other. S₅ further explains the usefulness of the mathematics subject to study other subjects, such as computer, population, economics, and many other subjects."

Utility value is a logical incentive that links mathematical understanding to more general educational and real-world applications, which may encourage continued participation even in the face of temporary interest.

Role of Personal Interest for Motivation

A strong factor in mathematics learning is intrinsic motivation from personal interest, which is defined by curiosity and enjoyment rather than by rewards from outside sources. Self-determination theory (Ryan & Deci, 2000) states that

real interest-driven autonomous motivation results in more sustained engagement than pressured regulated motivation. According to Frenzel et al. (2012), students' interest in mathematics decreases during adolescence, but those who remain personally demonstrate higher determination when faced with difficult material. Situational interest in mathematical activities can grow into a well-developed individual interest that maintains long-term engagement, according to Hidi and Renninger's (2006) four-phase model of interest development. Interest in mathematics was shown to be a strong predictor of achievement beyond past performance in a study by Singh et al. (2002), indicating that encouraging individual interest could enhance mathematical performance. Through intrinsic rewards, mathematical problem-solving induces "flow" states (Csikszentmihalyi, 1990), which further boost engagement and produce a self-sustaining loop of motivation. For several pupils, an innate interest in mathematics proved to be a strong motivator. Focusing on the issue of interest in mathematics, different students expressed their views. In this case, S_6 has views as:

"I am studying mathematics because I am interested in mathematics. In the same line, S_4 expressed: I am very much interested in mathematics (Student S_4). Likewise, S_5 states: "I used to score good marks (more than 80%) in all the examinations at my school level. If students are good at mathematics, then there is a culture of taking optional mathematics. I also read optional mathematics in school and obtained 3.6 in optional mathematics and a GPA of 4.0 in compulsory mathematics. These scores in mathematics motivated me towards this subject. Nowadays, I find it a bit difficult, but I am also trying to make it easy."

According to research on the formation of academic interest by Hidi and Renninger (2006), a personal interest promotes more engagement, determination, and information gain. Interest-based motivation is especially beneficial since it encourages independent engagement with difficult content and tends to promote deep learning strategies rather than surface-level ones (Vansteenkiste et al., 2006).

Consequence of Family Influence

Family circumstances have a significant impact on students' motivation in mathematics. According to Gunderson et al. (2012), children's attitudes and academic performance can be impacted by their parents' gender stereotypes and mathematics anxiety. Sheldon and Epstein (2005) discovered that certain family participation efforts have a favorable impact on mathematics achievement, demonstrating that parental involvement in mathematics instruction at home creates foundational energy. Through early support of mathematics-related activities, Simpkins et al. (2015) found that parents' perceptions of the value of mathematics and their own mathematical self-efficacy impacted children's motivating patterns.

According to the study by Pomerantz et al. (2007) on the quality of parent-children interactions during mathematics

homework, autonomy-supportive methods increase intrinsic motivation more than controlling ones. Cross-cultural research by Stevenson et al. (1990) shows how East Asian families' emphasis on effort in mathematics translates to different motivational patterns compared to Western families' greater focus on natural ability, demonstrating the considerable cultural differences in family influence.

Family expectations and focus emerged as an external motivational factor, as expressed by a student, S_1 :

"My family is focusing on studying mathematics, so I am studying mathematics. Further, my father is a farmer. He is doing hard work in the field to manage the money for the entire family, too. He is expecting financial support from me after completing my study. He used to say that if you read the mathematics subject, then you can get a job easily. You can earn extra money from the tuition classes, which is better for you and for us. Therefore, you have to study mathematics."

This result is consistent with the study by Ing (2014), who showed that parental influence had a major impact on students' achievement and course-taking habits in mathematics. One social aspect of motivation is family influence, which can involve aspects of support as well as pressure.

Role of Social Value

Peer relationships, classroom communities, and social identities associated with mathematics are the social components of motivation in mathematics. According to sociocultural theories of learning (Vygotsky, 1978), social contact is the primary means by which mathematical knowledge is created. According to Ryan and Patrick (2001), motivational outcomes were significantly influenced by students' evaluations of the social environment in mathematics classes, especially the support and encouragement of respect from teachers. According to research by Boaler and Staples (2008), mathematics-learning communities show how cooperative methods can change students' attitudes toward mathematics from passive consumption to active engagement. During adolescence, peer influences grow more significant. Nelson and DeBacker (2008) demonstrated that an individual's valuation of mathematics is significantly predicted by the value of mathematics as viewed by their friends. Participation in academic teams, clubs, and competitions gives mathematics accomplishment social worth for many students; resulting in what Hulleman et al. (2008) refer to as attainment value, which was reliable across both learning situations. Initial interest and mastery goals projected successive interest, and task values facilitated these relationships rather than relying just on individual success. These social ties foster motivation through a sense of recognition and belonging. Some students were motivated by the perceived social standing linked to mathematical careers or expertise, as demonstrated by the student S_7 as:

"I am studying mathematics because there is a high social

value of mathematics teachers in our society. The people in our society highly respect the mathematics teachers. They used to say, mathematics subject is very difficult. Only talented students can study mathematics (S7). They think students who study the mathematics subject are geniuses and laborious." (Students S₇)

This drive is linked to more general societal norms and views of mathematics as a noble academic discipline. Similar to this, Wang (2012) found that social recognition has a role in STEM career choices, especially in cultural situations where mastery of mathematics carries a high social capital.

Overcoming Challenges

One of the most essential components of long-term motivation is the ability to bounce back from mathematical difficulties. According to Dweck's (2006) growth mindset research, students who believe that mathematical intelligence is flexible rather than fixed are more persistent when faced with challenges. With this viewpoint, challenges are transformed from frightening events into chances for personal development. According to Warshauer (2015), the idea of productive struggle in mathematics education emphasizes how suitably difficult assignments combined with sufficient assistance promote deeper learning and motivation. According to Bandura's (1997) self-efficacy theory, conquering mathematical obstacles boosts confidence for upcoming ones, starting a positive feedback loop that increases motivation and success.

Mathematical self-efficacy affects performance even after adjusting for prior achievement and arithmetic anxiety. According to empirical research by Pajares and Graham (1999) resilience is promoted by educational strategies that normalize difficulty as a necessary component of learning rather than a sign of incapacity. Understanding the value of struggle itself becomes motivational, as evidenced by Yeager and Dweck (2012), who showed how teaching students about neuroplasticity and the brain's reaction to challenges enhances motivation, including performance on challenging mathematics assignments. Some students claimed that after being successful in their early mathematics challenges, they became more motivated towards the subject. In this context, a girl student studying in grade XII (S₅), has expressed her views as:

"I found mathematics was difficult at the beginning of my school years. Nowadays, I am improving a little bit in mathematics and feeling at ease with it. I did not obtain good marks in mathematics from the beginning. Most of our friends also failed in mathematics in school. Even though, it has a great scope to get a job in the future. Therefore, I have chosen this subject. Initially, I felt difficulties in understanding its terms, definitions, and theorems, but nowadays our mathematics teacher has been teaching by using technology with different dynamic figures. This method of teaching is very interesting and exciting. These days, I feel interested in mathematics and am trying to make it better." (student S₅)

According to research on resilience in mathematics

education (Johnston-Wilder & Lee, 2010) and growth mindset theory (Dweck, 2006), this component implies that making progress in spite of obstacles can boost motivation and self-efficacy. In the context of the use of ICT in mathematics learning Ghimire (2025) explored the ICT integration has positive effects for the development of cognitive abilities, by establishing foundational knowledge acquisition and higher-order thinking skills.

Discussion

The above-identified motivational components interact in difficult ways rather than functioning independently. For example, utility value may encourage perseverance when interest temporarily diminishes, whereas family influence may influence career goals. The fact that mathematics motivation is multifaceted supports the claim made by Middleton and Spanias (1999) as it is not a single, cohesive concept but rather consists of interconnected elements that evolve and shift over time. The use of different freely available digital tools has improved students' knowledge development, which helps to motivate students toward studying mathematics (Ghimire & Paudel, 2024). There were important consequences for educational practices from comprehending the various reasons, why students choose to study mathematics. Different motivational orientations can be accommodated in the learning experiences that were created by educators. Real-world applications emphasizing the utility value, whereas giving students a choice could encourage intrinsic interest (Linnenbrink Garcia et al., 2018). Beyond typical academic success, educators can highlight reasons that students should study mathematics, such as intellectual engagement, practical applications, and employment options. Students with varying motivational characteristics may find resonance in this multifaceted communication method (Murayama et al., 2013). Given that family influence is a motivating element, it is crucial to involve parents and establish support networks that encourage good attitudes and behaviors related to mathematics (Civil & Bernier, 2006). The overcoming challenges facet highlights the importance of specifically teaching children perseverance and resilience techniques in mathematics, assisting them in creating constructive solutions to issues (Johnston-Wilder & Lee, 2010). Research continuously shows that motivation is a dynamic process, which was affected by the relationships, experiences, and meaning making rather than just an intrinsic characteristic (Middleton & Spanias, 1999).

Since interventions focusing on individual motivational pathways frequently produce insufficient outcomes, effective mathematics teaching necessitates attention to this motivational ecosystem (Lazowski & Hulleman, 2016). The most promising educational strategies for promoting sustained mathematics engagement are those that simultaneously address several motivational pathways. Synergistic motivational effects can be produced by combining growth-oriented feedback, supportive classroom communities, real world applications, and links to students' identities and goals (Watt et al., 2016). According to Eccles

and Wigfield (2020), motivation should also be viewed as dynamic rather than static, with various motivating elements becoming more or less significant at various developmental stages and educational transitions.

Conclusion and Implications

Career aspirations, utilitarian value, personal interest, family influence, social worth, and overcoming obstacles are the six main motivating factors (that have been) identified in this article. It has been identified as influencing individuals' decisions to study mathematics. Teachers can create more successful teaching strategies for mathematics that speak to students' unique motives for studying the subject by having a better knowledge of these motivations. A tool for more research into these motivating elements in various educational environments is the proposed research questionnaire. An attainment of a broad understanding of the factors that encourage students to stick with their mathematical studies is still a key objective for educational research and practice, as mathematics continues to be a crucial filter for educational and employment prospects. A complicated, multifaceted entity, students' motivation for learning mathematics is influenced by a variety of interrelated contextual, societal, and personal factors. The above six categories that were examined, personal interest, family influence, career goals, utility value, social value, and overcoming obstacles, represent different but related ways that students can become and remain interested in mathematics. Recognizing and utilizing these many motivational pathways will be crucial, as mathematics education develops in order to foster mathematical competency and favorable attitudes toward mathematics in a variety of student populations. Developing learning settings that support various motivational styles while taking into account individual variances that motivates students to engage with mathematics is a challenge for educators, academics, and policymakers. Understanding these motivational factors, teachers can use the method of counselling to study mathematics.

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Conflict of Interest

The authors declare that there is no conflict of interest concerning the publication of this research.

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Authorship

The first author collected the data through FGD. The second author contributed to the review of the literature. Finally, both authors jointly contributed to the data analysis, interpretation of the findings, and finalizing the manuscript by discussing with each other.

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