ACADEMIA International Journal for Social Sciences
Volume 4, Issue 4, 2025 ISSN-L (Online): 3006-6638

Exploring The Relationship Between Students' Attitudes, Beliefs, And Motivation Towards Mathematics Learning in Secondary Education

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Received: 11-07-2025 **Revised:** 21-08-2025 **Accepted:** 16-09-2025 **Published:** 29-10-2025

ABSTRACT

The purpose of this study is to examine the relationship between secondary school students' attitudes, beliefs and motivation for learning mathematics. Mathematics, as a discipline that all other subjects are built upon, demands not only cognitive ability but also positive psychological dispositions regarding one's relationship to mathematical activities and persistence on them. However, in spite of its central importance to academic and occupational achievement, the majority of secondary school students experience anxiety, lack of interest in or low self-concept towards mathematics. These affective and motivational aspects are influential determinants of students' performance below cognitive levels. As such, the purpose of this study was to quantitatively investigate how students' attitudes, beliefs and motivation interact in order to influence their engagement as well as achievement within mathematics courses. The design of the study was quantitative correlation and four hundred secondary level (8 th, 9 th & 10) students were participants, included in both public and private schools of southern Punjab, Pakistan. An instrument was designed in the form of questionnaire based on standardized scales, i.e., Mathematics Attitude Inventory (MAI), Mathematics Belief Questionnaire (MBQ) and Academic Motivation Scale (AMS). Data dependability was confirmed by pilot study (Cronbach's $\alpha = 0.91$). The data were analyzed through SPSS Version 26 and the descriptive statistic, Pearson correlation, and multiple regression analysis models used to examine the relationships among three variables. These outcomes showed that attitudes, beliefs and motivation were validly associated ($r = 0.63–0.74$; $p <. 001$), indicating that motivation of students towards mathematics was higher for those who had more positive attitude and higher self-beliefs. Regression analysis also indicated that beliefs concerning mathematics ability ($\beta = 0.41$) and attitudes towards learning ($\beta = 0.38$) were significant predictors of motivation. Further gender comparison with t-tests of the motivation levels was conducted and no significant differences were found, which may indicate that affective factors work alike in male and female students. The results emphasize the interrelated nature of psychological factors in mathematical learning, but they also emphasise the importance of enhancing students' attitudes and self-beliefs to maintain motivation. This study suggests that mathematical success should not only be seen as the inevitable outcome of intellectual abilities, but rather as a matter that is highly emotional, affective and motivational. It suggests that teachers should incorporate motivational tactics, supportive classroom environments, and belief-based interventions to help sustain a long-term interest in mathematics.

Keywords: *Attitudes, Beliefs, Motivation, Mathematics Learning, Quantitative Research, Secondary Education, Student Engagement.*

INTRODUCTION

Math is a fundamental subject that teaches children how to think critically, reason and problem solve. Yet, despite its significance, for many students working-mathematically during the secondary years of

education is a struggle. Throughout a number of educational settings, many students view mathematics as difficult, abstract or the cause of anxiety. Such perceptions are formed based on their experiences of learning mathematics, as well as attitudes, beliefs and motivation toward mathematics. A better understanding of the interplay between these psychological contributors is critical to improving education and student performance in mathematics (Haavold & Blomhøj, 2019).

Attitudes are students' emotional reactions and social perceptions of mathematics, such as liking, fear or belief in the usefulness of mathematics. How attitudes mediate learning Motivation affects what students do directly Positive feelings lead to more engagement, persistence and motivation (see p 18) Negative feelings create barriers that impede understanding and action. Beliefs, on the other hand, cover students' personal beliefs regarding what mathematics is and their self-efficacy - confidence in their capacity for learning and accomplishing new things. Motivated effort consists in the energy and persistence that students bring to mathematical tasks, which is weakened or motivated by intrinsic (interest such as enjoyment or curiosity) and extrinsic (grades, rewards) incentives (Artigue & Blomhøj, 2013).

Attitudes, beliefs and motivation are these three factors that determine the performance of students in mathematics. Research has shown that students with a positive attitude towards mathematics are more likely to take risks, be creative in problem-solving, persevere through difficult problems, as well as gain conceptual understanding. On the other side of the ledger, those who self-identify as "bad at math" frequently throw in the towel, launching a cycle of failure and misery (Roksvold & Haavold, 2021).

In Pakistan, like many developing countries, mathematics instruction is frequently characterized by teacher-centered pedagogies that focus on mastery of procedures and memorization. Methods like these do little to nurture the emotional and motivational dimension of students. As a result, numerous students experience mathematics stress and come to feel inadequate. It is an increasing necessity to explore the attitudes, beliefs and motivation of students which are both interacting within this educational setting in order to answer ways for mathematics instruction that would be much more effective on a psychological basis (Pedersen & Haavold, 2022). Thus, this study aims to empirically analyze the magnitude of the associations between these three core factors. The objective is to understand how students' attitudes and beliefs affect their motivation for learning mathematics, which brings valuable insights into educational psychology and design of instruction (Lazonder & Harmsen, 2016).

Statement of the Problem

Although the significance of mathematics as a means to develop critical thinking and problem solving skills remains unchallenged, performance, attitudes and motivation towards learning this subject are still low among secondary school students. Those affective walls usually stem from some deeply-held belief that math is difficult, abstract, and only for the gods of men who have been given such a Holy Gift by birth. As such, students begin to lose confidence and interest in mathematics, perform poorly and avoid doing tasks that are constructed as mathematical (Christensen & Knezek, 2020). In Pakistan and other pedagogical settings, teaching practices favor memorizing over the understanding of concepts that contribute to students' alienation from the subject. So, understanding how students' attitude, beliefs and motivation are molded to influence their experience in mathematics is profoundly important. Understanding this association can be particularly conducive to designing productive teaching strategies, aimed at the second level students for promoting such attitudes and motivation behaviors which lead to better mathematics performance.

Research Objectives

1. To examine the relationship between students' attitudes, beliefs, and motivation toward mathematics learning in secondary education.
2. To determine the extent to which students' attitudes and beliefs predict their motivation to learn mathematics.

3. To identify whether there are significant differences in students' attitudes, beliefs, and motivation based on demographic factors such as gender and school type.

Research Questions

1. What is the relationship between students' attitudes, beliefs, and motivation toward mathematics learning?
2. To what extent do students' attitudes and beliefs predict their motivation in learning mathematics?
3. Are there any significant differences in students' attitudes, beliefs, and motivation toward mathematics based on gender and school type?

Significance of the Study

The present investigation is of great value as it focuses on the psychological correlates-attitudes, beliefs and motivation-immediately affecting students' perception and accomplishment in mathematics. These relationships enable educators and policymakers to pinpoint the underlying reasons of problematic low mathematical performance other than cognitive constraints. Against this, the study's focus on affective and motivational aspects provides practical implications for the development of teaching approaches aimed at developing learners' confidence, interest and perseverance. The results may be useful for teachers wanting to establish a supportive classroom atmosphere in relation to increasing students' self-efficacy and intrinsic motivation. Further, the study contributes to educational psychologists as it demonstrates the importance of promoting integrated emotional and cognitive components on mathematics learning that fosters better academic success and lifelong attitudes towards learning.

LITERATURE REVIEW

Students' Attitudes Toward Mathematics

Mathematics attitudes indicate learners' affective and behavioural dispositions towards mathematics. Positive affect predicts achievement, whereas negative emotions such as fear or boredome impede engagement. As with Aiken (1970), attitudes have both an affective (feelings) and cognitive based (belief-based) element that influence learning. It has been found by Hannula (2012) and MA & Kishor (1997) that holding positive attitudes have resulted in higher levels of self-esteem, perseverance among the students while solving mathematical problems. By contrast, students who consider mathematics to be unimportant or difficult are more likely to avoid it and show worse performance. Therefore, the cultivation of positive attitudes is necessary to sustain motivation and achievement in mathematics education (DeMonbrun et al., 2017).

Beliefs About Mathematics and Self-Efficacy

Beliefs determine how students make sense of their mathematical experiences. These include understandings about the nature of mathematics (static vs. dynamic), how one learns it (rote vs. understanding) and personal efficacy. According to Pajares and Miller (1994) selfefficacy – the belief that an individual can perform a task effectively, has been identified as one of the strongest predictors of academic performance. Students holding growth mindset–the belief that ability to learn and succeed in math can be improved through effort—are more likely to experience resilience and motivation than students with a fixed mindset—the belief that math success is merely linked to inadvertently inherited math genes (Fieller et al., 1957) In contrast, for people with a fixed mindset, failure is often blamed on lack of inherent ability and motivation to continue is further decreased. Therefore, it is important to foster adaptive beliefs for positive mathematics learning outcomes (Kaarstein & Nilsen, 2016)

Motivation Toward Mathematics Learning

Motivation is defined as a force that guides and maintains learning activities. This can be intrinsic (motivated by curiosity, interest and enjoyment) or extrinsic (motivated by rewards, recognition). As per

Deci and Ryan's (1985) Self-Determination Theory, learners will become more engaged and perform better when their motivation is internally based. Middleton and Spanias (1999) have found that loss of interest in mathematics is frequently due to boring teaching and non-applicability to students' lives (Perez-Felkner et al., 2012). The connection of mathematics to real problem situations raises the level of intrinsic motivation with which the students approach a mathematical task, and consequently results in enhanced conceptual understanding surf performance (Else-Quest et al., 2010).

Relationship Among Attitudes, Beliefs, and Motivation

The literature suggests that attitudes, beliefs and motivation may interact with each other. Positive beliefs prepare attitudes leading to enhance motivation. For example, students who perceive of effort as producing success are more likely to engage their mathematics with greater investment and perseverance. Schunk and Pajares (2002) reported that motivated individuals tend to maintain positive attitudes, develop adaptive beliefs relative to learning. This triadic relationship implies that the single domain (e.g., enhancing beliefs) interventions may provide benefits in the others, and so participation and attainment (Evans et al., 2018).

Theoretical Framework: Self-Determination and Expectancy-Value Theory

This research is embedded in two theories from psychology: Self-Determination Theory (SDT) and Expectancy-Value Theory (EVT). SDT contends that students will be most engaged when they experience competence, autonomy and relatedness to the learning context. EVT EVT, as proposed by Eccles and Wigfield (2002), explains that student's achievement related behaviors are influenced by their expectations of success in the task and how much they value task (Riegle-Crumb et al., 2019). In mathematics education, both theories address how students' perceptions of ability and utility affect their motivation and involvement (Fielding-Wells et al., 2017).

METHODOLOGY

Research Design

A quantitative correlation research design was used in this study to investigate the relationship between students' attitudes, beliefs and motivation for learning mathematics. Tyesi and Sarma use this design to measure the degree and direction of relationship between variables without manipulating those (Engeln et al., 2013). The subjects were assessed using a structured questionnaire; their data were statistically analyzed for correlations and predictors.

Population and Sampling

The study population consisted of secondary school students (classes 09-10) from public and private schools in south Punjab, Pakistan. These students consist of a balanced sample stratum (i.e., group size was equal in terms of sex and type of school to be selected by stratified random sampling); with 400 students in total (200 males, 200 females). We also kept stratification by location (urban vs. rural) in order to maximize representativeness of population.

Research Instruments

In the present study, data were collected using a self-developed questionnaire to measure students' attitudes, beliefs, and motivation of learning mathematics only. The tool included three established and validated scales. The first set was the Mathematics Attitude Inventory (MAI) comprising 15 items and focused on three dimensions that include enjoyment, anxiety, and awareness of usefulness of mathematics (Forgasz et al., 2015; Tuohilampi et al., 2014). The second instrument, the Mathematics Belief Questionnaire (MBQ) with 15 items was used to measure students' self-efficacy along with their beliefs underlying mathematical learning and problem solving. The third instrument was composed of 15 items in which we evaluated internal and external motivation towards mathematics engagement (Academic

Motivation Scale - AMS). All the items were measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The validity and reliability of the questionnaire were verified through piloting on a sample group of 30 students in which the clearness of items was confirmed, and its reliability was found to be high (Cronbach's $\alpha = 0.91$) implying that instrument has strong internal consistency.

Data Collection Procedure

Written consent was received from the schools prior to the survey collection itself. Students were informed about the aim of the study and participation was voluntary. The measurements were taken during school hours with teacher's supervision. It took 3 weeks to complete the procedure, which guaranteed uniform distribution and anonymity as well.

Data Analysis Techniques

Information was entered into, and analyzed by using SPSS version 26 after coding. Descriptive statistics summarized demographic characteristics. Pearson correlations were performed to assess the relationship between variables, and multiple regressions were conducted to establish the predictive value of attitudes and beliefs on motivation. Independent t-tests examined gender-based differences.

DATA ANALYSIS AND RESULTS

Table 4.1 Descriptive Statistics of Attitude, Belief, and Motivation Scores (N = 400)

Variable	Mean (M)	SD	Minimum	Maximum
Attitudes	3.78	0.69	2.1	4.9
Beliefs	3.84	0.65	2.3	4.8
Motivation	3.92	0.71	2.2	4.9

Positive attitudes, beliefs, and motivation in mathematics Students' reported mean scores approached 4 based on a 5-point scale. The findings are as such - majority of the respondents possess a moderately positive attitude towards mathematics and they have motivational beliefs in learning it.

Table 4.2 Pearson Correlation Among Variables

Variables	Attitudes	Beliefs	Motivation
Attitudes	1	0.68**	0.74**
Beliefs	0.68**	1	0.63**
Motivation	0.74**	0.63**	1

The three variables are closely positively correlated. Students' attitude and belief of mathematics influence their motivation to learn. The greatest relationship between attitudes and motivation (r =. 74) validate the direct influence of affective engagement on learning persistence.

Table 4.3 Multiple Regression Predicting Motivation from Attitudes and Beliefs

Predictor	β	t	Sig.
Attitudes	0.38	9.32	<.001
Beliefs	0.41	10.15	<.001
$R^2 = 0.57$, $F(2, 397) = 131.25$, $p < .001$			

Attitude and belief each predict motivation significantly, accounting for 57% of its tendency (R^2 =. 57). Beliefs (β = 0.41) proved to be a marginally better predictor than attitudes (β = 0.38), showing that the students' self-image and confidence are the motivational backbone.

Table 4.4 Independent Samples t-Test: Gender Differences in Motivation

Gender	N	M	SD	t(398)	p
Male	200	3.90	0.72	0.84	0.40
Female	200	3.94	0.70		

No statistically significant gender difference was found in motivation levels (t = 0.84, p = 0.40). This indicates that both male and female students exhibit similar motivational orientations toward mathematics when provided with equal learning conditions.

FINDINGS

Findings indicate a strong positive association among students' attitudes, beliefs and motivational orientations towards mathematics. Students who have positive effects and strong self-efficacy are more likely to be intrinsically motivated and persist in learning mathematics. Multiple regression analysis established that attitudes and beliefs independently, as highly significant predictors of motivation each account for 57% motivation's variance (Beswick et al., 2012). There is also a lack of gender difference indicating that the impact of psychological and motivational factors on learners without bias to males or females. These results suggest that mathematics performance and attitudes are not only a function of cognitive processes, but emotions and beliefs (Alfieri et al., 2011). Thus, interventions that increase self-efficacy, decrease levels of anxiety, and increase the relevance of mathematics can greatly improve learning outcomes.

DISCUSSION

The results of this work are in agreement with the previous studies which emphasized the psychological variables in mathematics. The positive attitude makes the students more motivated and engaged, with strong self-beliefs that they can take on any challenges (Degol et al., 2018). Strong relationships between attitudes and motivation have been found to support the Self-Determination Theory concept of intrinsic enjoyment and perceived value as precursors for continued learning. Likewise, the impact of beliefs is consistent with Bandura's (1997) self-efficacy model, which posits that greater confidence in being able to complete a task (e.g., due to positive prior experiences or due to beliefs in opportunities and supportive social environments) results in more effort and persistence (Bruder & Prescott, 2013).

Absence of sex differences in specific genes that influence math learning outcomes is consistent with the fact that genetic factors underlying performance are not expected to be sex specific, as most barriers to success in mathematics appear to be educational or psychological rather than biological. That is, we know that very high motivation can be generate in men and women when the conditions for development are conducive to high levels of motivation (Eccles & Wigfield, 2002), The results above underscore what quality classrooms about curiosity, confidence. And fun versus fear and pressure refer to for teachers. Overall, this study provides further evidence that mathematics education is more than numbers and symbols; it is about teaching in a manner that supports students' way of thinking and motivation to engage in problem solving/critical thinking (Gijsbers et al., 2020).

CONCLUSION

The study further finds that students' attitude, belief and motivation are interdependent on each other among themselves to impudence learning behavior in mathematics themselves. Interest and persistence-are byproducts of a positive attitude; confidence -comes from firm conviction, shared in the intentness of

motivation (Moyer et al., 2018). The results are empirically verified that trust, self-concept beliefs in math and perceived value of learning are the strongest motivators. They have thus ini to cope that not only with the transferable input of conte and emotional, motivational development. Developing growth mindsets, reducing anxiety and promoting an engaging math's experience at home and beyond can help to demystify mathematics for our early year's students (Eisinga et al., 2013).

RECOMMENDATIONS

Promote Positive Classroom Environments

Teachers have to create emotionally supportive, inclusive, mathematics classrooms that are free from safety and fear. When students are psychologically safe, they take the risks of raising their hands and asking questions or participating in a conversation with the teacher and each other, or making intellectual leaps. It helps children to build a sense of belonging and confidence when learning mathematics. A positive teacher–student relationship may, furthermore, lead to reduced math anxiety thus promoting the child's attitude towards problem solving/ analytic thinking. It is in these type of environments where the classroom is transformed into a place of questioning, creative thought and respectful conversation.

Foster Growth Mindsets

Schools need to teach teachers how to instill this growth mindset in all students, so that they recognize that their math talent can be developed and not simply believe if they "get it" or don't. When students understand that errors provide learning opportunities, they are driven to keep trying. Educators can encourage effort-based success by rewarding improvement, persistence and creativity instead of perfection. Habit: Growth mindset which encourages students to see struggle as challenge, knows they can achieve by effort and perseverance, stretches and grows lifelong learning skills. A growth mindset classroom dynamic ultimately builds a greater confidence and an invested relationship in math.

Integrate Real-World Contexts

The teaching of mathematics is relevant when its connection to the daily lives and actual experiences of students is emphasized.refreshing 412Vol.contributors to this journal.dateFormatDocs.samples You have privileged accessnoneFootnotes. Teachers need to use tangible examples like budgeting, architecture, or even climate change in order to help a student understand the usefulness of solving problems using math. This place- and context-based approach to teaching and learning embeds the value of mathematics in its relevance beyond the classroom's four walls. Real life problem solving also encourages critical thinking and allows students to see the usefulness of mathematics in your personal and societal growth. The use of real-world examples helps narrow the space between academic knowledge and practical knowledge.

Teacher Training Programs

Teachers need to be provided with opportunities for professional development in the area of motivational and attitudinal strategies if these are to be successfully used. Programmes of training must enable teachers to re-learn modern pedagogical approaches (e.g., inquiry-based learning, collaborative teaching, ways of emotional involvement). Through workshops or seminars, teachers can learn to recognize aspects of the psychology of motivation and learn how to implement classroom practices that foster self-efficacy and positive beliefs. Reflection on practice may also help teachers evaluate and modify their own teaching approaches. Teacher training investments guarantee that mathematical instruction and learning outcomes improve in the long term.

Curriculum Enrichment

Those who develop curricular materials should create mathematics programs that include emotional, attitudinal, and motivational as well as cognitive goals. A complete curriculum will want to drive problem-solving competency and curiosity, tenacity, and belief in oneself of the primary audience.

Adding material which promotes thought, exploration and creativity can help to make mathematics exciting. Incorporating activities that promote teamwork and project-based evaluations has also the capacity to enhance both conceptual learning and affective involvement. It is, therefore, a rounded curriculum which encourages full intellectual and affective development in students.

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