Exploring the Interplay of Beliefs and Values: A PLS-SEM Investigation into Self, Teacher, and Math Beliefs, and their Impact on Math Value

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Abstract

This study used a quantitative research design to examine the complex structure of students' beliefs in mathematics education among Karachi eighth-grade students. Thirteen randomly chosen private schools produced a total of 130 students—65 boys and 65 girls. The research explored how students' beliefs specifically Belief about Self (BAS), Belief about Teacher (BAT), and Belief about Math (BAM) influence the perceived value of mathematics. Structural Equation Modeling (PLS-SEM) was used to analyze both direct and indirect relationships among these constructs. The findings indicated a strong correlation between students' perceptions of their personal capacity and their value in math. The study also examined how gender mediated the relationship between various belief systems, highlighting the significance of a positive teacher-student relationship in raising the value of mathematics. The results support the design of evidence-based interventions that could improve mathematics education as well as for the establishment of supportive learning environments that promote the value of mathematics.

Keywords: *Belief about math, belief about self, belief about teacher, math value*

1. Introduction

Beliefs are fundamental mental models that influence attitudes, perceptions, and actions. An individual's beliefs, whether empowering or limiting, have a significant impact on their actions, goals, and outcomes. Achievement may be impeded by the lack of congruent internal belief structures, even when actions correspond with externally defined success metrics. On the other hand, effective performance in the personal, academic, and professional spheres is facilitated by aligned beliefs and behaviors (Yeager et al., 2023). Every behavioral tendency is based on an implicit or explicit belief that drives persistence, motivation, and decision-making.

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Beliefs operate together with behaviors to serve as cognitive filters within which experiences are appraised and actions are prioritized. Belief schemas are generally formed automatically by early learning experiences, cultural influences, and social exchanges. Even when beliefs go largely unevaluated they inform how effort is valued, the meaning of success, and the perception of adversity and struggling (Eccles & Wigfield, 2020). When beliefs are inappropriate and maladaptive, they can limit potential. However, with critical thinking and appropriate intervention, limiting beliefs can be made adaptive and empowering (Schunk & DiBenedetto, 2021).

The power of belief systems and their implications are particularly important in educational settings (Ballan, 2023. Beliefs impact how learning is conceptualized, how commitment to effort is maintained, and how failure is understood. In mathematics education, belief systems affect not only attitudes towards mathematics, but also achievement outcomes and future trajectories. Empowering belief systems regarding mathematics, self, and teachers are associated with increased engagement, improved achievement, and enhanced emotional responses toward learning tasks (Piyakun & Phusee-Orn, 2025).

Beliefs can encourage or hinder the development of adaptive learning behaviors. Empowering beliefs enhance cognitive and emotional resources, which support goal-setting, self-regulation, and persistence. Alternatively, limiting beliefs are associated with avoidance, anxiety, and disengagement, particularly in competitive or high-stakes contexts. Therefore, as the role of belief systems in education is not isolated to cognition, belief systems extend to motivational and emotional reactions and consequences (Bakhtiar & Hadwin, 2022).

Recent models in motivational psychology highlight that high performance across contexts is typically supported by an established system of beliefs that self-generate highly optimal performance, even in pressured contexts. The nature of belief is linked to four basic functions: visualizing, willpower enhancement, resiliency, and the activation of sustained effort (Kight, 2020; Yeager et al., 2023). As such, understanding and reshaping belief systems, represents a prominent way to enhance academic motivation and value attribution in a school context, especially in regards to mathematics.

1.1 Objectives of the Study

The objectives of the study included to;

1. examine and estimate the hypothesized relationships among Belief about Self (BAS), Belief about Teacher (BAT), Belief about Math (BAM), and Math Value (MV).

2. identify the relative importance of each belief factor in predicting mathematics value.
3. evaluate the serial mediation effect of BAT, and BAM between BAS and MV (BAS → BAT → BAM → MV).
4. test the moderated mediation effects in the model, taking age of students as a moderator (Gender × BAT → BAM → MV).

1.2 Hypotheses of the Study

Following alternate hypotheses were designed;

H_1: Beliefs about Self (BAS) positively predicts beliefs about teacher (BAT).

H_2: Beliefs about Teacher (BAT) positively predicts Beliefs about Math (BAM).

H_3: Beliefs about Math (BAM) positively predicted Math Value (MV).

H_4: Beliefs about Teacher (BAT) positively predicts Math Value (MV).

H_5: BAS has an indirect effect on MV by means of BAT and BAM (serial mediation).

H_6: The relationship between BAT and BAM is moderated by gender.

H_7: BAS has no direct effect on MV.

1.3 Significance of the Study

The research adds to the literature by offering a structural model that arrests the collective influence of students’ beliefs about themselves, their teachers, and mathematics, on the value students place on mathematics. The use of PLS-SEM was able to document direct and mediated, belief-system interactions and hold some implications for designing belief-based interventions in middle school mathematics. Moreover, as a moderator, the inclusion of gender supports the applicability of findings across many classroom contexts. The research is likely to have wide implications for preparing teachers, creating curriculum, and designing school level activities to increase students’ engagement and achievement in mathematics.

1.4 Delimitations of the Study

The scope of the study was limited to eighth grade students attending private institutions in the District East Karachi only. Participants in the research were not only present during school informal and survey visits, but students also declared their participation voluntarily. The constructs were limited to students' beliefs about self, teacher, and mathematics without consideration of other variables that may have been noteworthy, such as parental influence, student attitudes of peers, or socioeconomic status. The data comprised self-reported measures and may be subject to perceptual bias.

2. Literature Review

This study investigates the influence of students' beliefs about self, teachers and mathematics on their perceived value of mathematics. In order to explore how the belief systems reflectively and interactively contribute to students' motivation and engagement in their academic studies particularly as it relates to their mathematical training it needs to review the literature described in the following section. The literature review identifies theoretical bases and empirical studies about belief about self, belief about teachers, belief about mathematics, and perceived value of mathematics. Each of these areas is discussed separately so that their collective significance can be discerned. At the same time, links between the literature are also acknowledged. Through the review, the study hopes to expose conceptual gaps, and provide support for the structural model that was used as an organizing structure for the investigation

Belief about Self (self-efficacy) refers to an individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments (Bandura, 1977). These self-beliefs impact every aspect of the human experience, such as the objectives people pursue, the amount of effort they put forth to achieve those objectives, and the probability of achieving specific behavioral performance levels. According to Valentine et al. (2004), there is a moderate positive correlation between positive self-beliefs and academic achievement. This correlation is stronger when the self-beliefs are specific to the academic field and the measures are matched by field. Therefore, students' personal beliefs about doing mathematics (Math self-efficacy) are of great importance and are strong predictors of long-term achievement outcomes (Parker et al., 2014; Stankov & Lee, 2017). Math competence beliefs positively impact achievement and perceived effort expenditure (Pinxten et al., 2014). Academic self-beliefs and prior knowledge are powerful indicators of students' success in mathematics; self-beliefs also predict achievement indirectly through prior knowledge (Hailikari, 2008).

While self-efficacy shapes a learner's confidence and persistence, domain-specific beliefs such as beliefs about mathematics determine how students perceive the subject itself and the value they attach to mastering it. Belief about Mathematics is students' views about the nature of mathematics, and its utility, generally based on their personal learning experiences about it (Liljedahl, 2005). Belief about Mathematics plays a significant role in the teaching and learning of mathematics. Students' views and beliefs about mathematics have a significant impact on their learning outcomes (Alfaro Víquez & Joutsenlahti, 2021; Furinghetti & Pehkonen, 2000). As a result, it is important to consider students' beliefs when evaluating or assessing their mathematical knowledge. Kloosterman (2002) observes a clear link between effort and belief. A student's belief is something they know or feel, and it influences their effort i.e. their effort to learn mathematics. Furthermore, Kloosterman (2002) contends that students make decisions based on both personal objectives and beliefs. As a result, decisions and beliefs are closely related. Several studies have shown that there are gender disparities in the attitudes and beliefs around mathematics. According to Else-Quest et al. (2010), boys tend to have more positive attitudes towards learning mathematics, whereas Perez-Felkner et al. (2012) found that girls have lower levels of self-confidence.

Math value is a reflection of how much people value, find useful, and relate to mathematics in their daily lives. It includes the value that mathematics has for a person on a personal level as well as academic and professional ones. People who think math is important are more likely to participate in math-related activities, put effort into understanding math concepts, and persevere in the face of difficulties (Gaspard et al., 2015). According to research, students' academic motivation, engagement, and achievement are significantly influenced by their perception of the value of math (Bakhtiar & Hadwin, 2022; Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). Students who find math personally meaningful and helpful are more likely to put in effort, stick with it through difficulties, and excel academically (Dicke et al., 2021). According to some studies, boys are more likely to concur that mathematics is important when it comes to utility value (Gaspard et al., 2014; Perez-Felkner et al., 2012). According to Macnab (2000), higher TIMSS performing nations demonstrate a coherent vision for math education that is informed by value and purpose-driven belief systems, which is essential for successful classroom implementation.

Belief about Teacher refers to how students view the skill, encouragement, and efficacy of their math teachers. Positive BAT has been linked in studies to increased academic engagement, self-assurance, and math achievement (Midgley et al., 1988; Muijs & Reynolds, 2002). Furthermore, teachers' perceptions of their own effectiveness and methods of instruction have a big influence on students' BAT and the mathematics achievement that follow (Bandura, 1977). Studies reveal that teachers' perceptions of their students' potential and abilities can affect students' perceptions of their teachers and their subsequent academic results (Piyakun & Phusee-Orn, 2025). Hattie (2008) highlighted how teachers' expectations shape students' performance and self-concept and how teachers' beliefs affect students' academic success.

The intricate relationship between belief systems and math achievement are being investigated in recent research. For instance, the association between math achievement and BAS may be moderated by individual variations in BAM

(Skaalvik & Skaalvik, 2006). Interventions that target multiple beliefs about self, school, and learning at the same time have shown synergistic effects on motivation and performance (Yeager et al., 2023). These results highlight the necessity of conducting a thorough analysis of belief systems and the complex interactions that shape math outcomes. It is therefore, important for instructional strategies, curriculum development, and teacher preparation to comprehend the complex nature of belief systems and how they affect math education. Interventions that target negative attitudes and beliefs about math can also improve students' motivation, engagement, and academic success in the subject. The goal of this study is to better understand the intricate relationship between belief systems and math value by evaluating the moderating effects of gender in this model as well as the mediating roles of BAT and BAM.

3. Research Methodology

3.1 Research Design

The study implemented a quantitative, cross-sectional research methodology to assess the relationships between students' beliefs and their perceived utilization of mathematics. The analytical method Partial Least Squares Structural Equation Modeling (PLS-SEM) was selected as the overall method of analysis, which is appropriate for modeling complex relationships among latent variables.

3.2 Population and Sampling

The target population comprised Grade VIII students from private schools in District East, Karachi. A random sampling technique was applied to randomly select 20 schools; however, permission was granted from only 13 schools. Schools that granted access may differ systematically in terms of administrative support, student demographics, or academic emphasis. Therefore, the findings may not be fully generalizable to all private schools in District East Karachi. From these schools, 130 students were randomly selected as a sample for the study, with an equal number of boys and girls (65 boys and 65 girls). This sample size was considered adequate for PLS-SEM analysis.

3.3 Instrumentation

The instrument was comprised of four reflective scales. Each construct was measured using established items adapted from previously validated instruments.

- Belief About Self (BAS): 5 items adapted from Bandura's self-efficacy model (1977). An example item is: "*If I try hard enough, I can solve difficult assignments in mathematics class*."
- Belief About Teacher (BAT): 10 items adapted from Midgley et al. (1988) and Muijs & Reynolds (2002) defining the teacher's perceived

support, pedagogical competency and encouragement. An example item is: "*My math teacher explains things in a way that makes sense to me*."

- Belief About Math (BAM): 6 items adapted from Liljedahl (2005) and Kloosterman (2002). An example items is: "*Mathematics is useful in real life*."
- Math Value (MV): 11 items adapted from Eccles & Wigfield's (2002) expectancy-value model. An example item is: "*I find math interesting and like doing math*."

Responses for all four reflective scales were collected using a 5-item Likert scale from 1 (strongly disagree) to 5 (strongly agree). Towards progressing through the confirmatory factor analysis phase, items with factor loadings below 0.7 and p-values greater than 0.05 were eliminated to improve the construct validity. The final instrument only had items with acceptable psychometric properties.

3.4 Data Collection

Data were collected via direct visits made to each of the participating schools. All before the survey was administered; informed consent was secured from the school authorities. At all schools, students filled out the questionnaire in class time and under the supervision of the researcher to standardize a data collection process.

4. Data Analysis and Interpretations

The latent variable structural equation model was estimated using Smart-PLS 4 software. Before examining the structural relationships, it was to specify and validate the measurement, including the constructs and their indicators. The model was examined against various fit indices and reliability indices (i.e., different measures of consistency) based on the models' fit indices, including factor loading, Composite Reliability (CR), Average Variance Extracted (AVE), and Cronbach's Alpha, all of which met the minimum threshold values that are recommended for validity and reliability. This procedure assured that the theoretical model adequately fit the data before testing for the hypothesized relationships.

Confirmatory Factor Analysis (CFA) was performed on the measurement model using Smart PLS (version-4). The factor loadings for each item were determined as part of the confirmatory factor analysis procedure. Since all factor loadings were greater than 0.50, no item was removed from any construct. The four constructs (M1, M2, MEng, and MAch) had a good fit to the data (CMIN/df = 2.779, GFI =.911, CFI = 0.902, TLI = 0.907, SRMR = 0.071, and RMSEA = 0.067). Cronbach's Alpha and Composite Reliability (Table 2) were used to assess construct reliability in the study, and both were found to be within acceptable ranges (Hair et al., 2010; Nunnally & Bernstein, 1994). The convergent validity (Table 2) of each construct was also established because each AVE value was greater than 0.50 (Fornell & Larcker, 1981). For discriminant validity, both Fornell and Larker (Table 3) and the HTMT ratio (Table 4) criteria were applied. The square root of AVE was greater than its correlation with the other constructs in the study (Fornell & Larcker, 1981), and all HTMT ratios fell below the 0.85 threshold (Henseler et al., 2015). The HTMT (Heterotrait-Monotrait) ratio tests whether constructs are truly distinct from one another (discriminant validity).

Table 1

Loadings, Reliability, and Convergent Validity

	Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
BAM		0.648	0.743	0.541
BAM1	0.891			
BAM2	0.741			
BAM3	0.332			
BAS		0.722	0.793	0.646
BAS1	0.837			
BAS2	0.869			
BAS3	0.694			
BAT		0.863	0.873	0.599
BAT1	0.784			
BAT2	0.654			
BAT3	0.869			
BAT4	0.683			
BAT5	0.769			
BAT6	0.858			
MV		0.808	0.822	0.515
MV1	0.689			
MV2	0.810			
MV3	0.799			
MV4	0.742			
MV5	0.558			
MV6	0.679			

Table 2
Fornell & Larcker Criterion

	BAM	BAS	BAT	Gender	MV
BAM	**0.696**				
BAS	0.450	**0.804**			
BAT	0.516	0.701	**0.774**		
Gender	0.360	0.360	0.205	**1.000**	
MV	0.587	0.627	0.714	0.335	**0.718**

Note. Bold values are square root of AVE

Table 3
Heterotrait-Monotrait (HTMT) Ratio

	BAM	BAS	BAT	Gender	MV	Gender × BAT
BAM						
BAS	0.672					
BAT	0.714	0.804				
Gender	0.599	0.411	0.242			
MV	0.842	0.806	0.837	0.372		
Gender × BAT	0.247	0.515	0.702	0.155	0.505	

The structural model is displayed in Figure 1. The moderation and mediation analysis results are shown in Table 4-6.

Figure 1
Structural Model

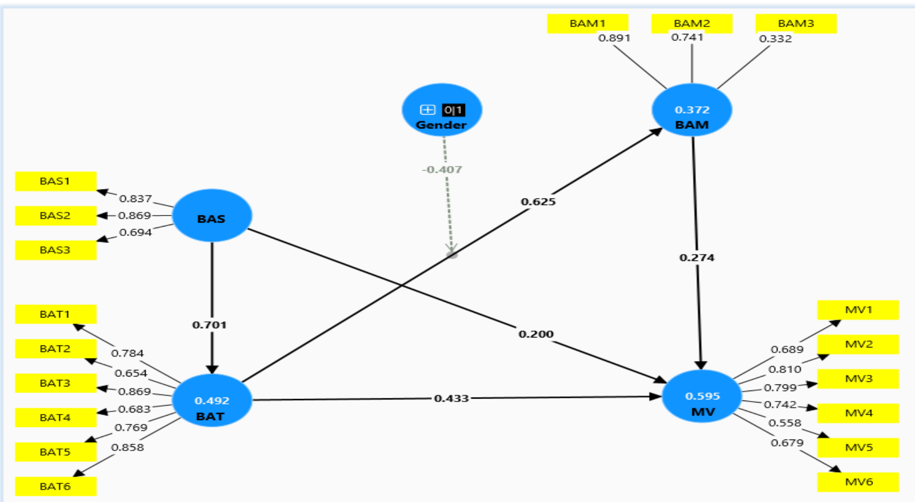

Table 4
Path Coefficients

Path	β	t-value	p-value	Result
BAM → MV	0.274	2.718	0.007	Supported**
BAS → BAT	0.701	10.907	0.000	Supported***
BAS → MV	0.200	1.403	0.161	Not Supported
BAT → BAM	0.625	5.915	0.000	Supported***
BAT → MV	0.433	3.417	0.001	Supported**
Gender → BAM	0.544	2.438	0.015	Supported*
Gender × BAT → BAM	-0.407	2.346	0.019	Supported*

*Note. BAM = Belief About Mathematics, BAS = Belief About Self, BAT = Belief About Teacher, MV = Mathematics Value, *p < .05, **p < .01, ***p < .001*

Table 4 shows the direct effects within the structural model. Five of the seven paths were statistically significant. BAS did not significantly affect MV (β = 0.200, t = 1.403, p =.161). This shows that just because someone is confident in themselves does not guarantee that they will see math as more valuable or important, and vice versa. This finding suggests that interventions aimed at increasing students' self-belief may not always result in increased value or importance for math. Similarly, efforts to emphasize the importance of math may have little impact on students' self-confidence.

Significant direct effect of BAM → MV (β = 0.274, t = 2.718, p <.01), and BAT → MV (β = 0.433, t = 3.417, p <.01), was observed which indicates that BAM and BAT are influential factors in determining an individual's perception of the importance of mathematics. This shows that one's perception of math as a subject, as well as their opinion of their teacher's ability to teach math, have a significant impact on how important or valuable mathematical skills or achievements are to them. The results indicate that individuals are more likely to see math as essential or valuable if they have strong positive beliefs about math in general and have trust in the competence of their teachers. This suggests that students may value math more when they have teachers who are seen as competent and who can make them feel confident and interested in the subject.

When gender is taken into account as a moderating factor, the effect of BAT on BAM is not constant across genders (β = -0.407, t = 2.346, p <.05). This indicates that an individual's gender affects the relationship between belief about math (BAM) and belief about the teacher (BAT). This means that impact of positive belief about teacher (BAT) on belief about mathematics (BAM) is stronger in boys as compared to girls. This implies that, when looking at gender, BAT, and BAM together, a more complex relationship is found than at each component separately. It emphasizes how a student's perception of their teacher shapes their perception of math, and how gender plays a role in this.

Table 5

Mediation Effects

Path	β	t-value	p-value	Result
BAS → BAT → MV	0.304	3.245	0.001	Supported**
BAT→ BAM→ MV	0.171	2.644	0.008	Supported**
Gender→ BAM→ MV	0.149	1.647	0.100	Not Supported
BAS → BAT → BAM → MV	0.120	2.608	0.009	Supported**
BAS → BAT → BAM	0.439	5.093	0.000	Supported***

*Note. BAM = Belief About Mathematics, BAS = Belief About Self, BAT = Belief About Teacher, MV = Mathematics Value, *p < .05, **p < .01, ***p < .001*

A mediation analysis was performed to investigate whether Belief about Teacher (BAT) mediates the relationship between Belief about Self (BAS) and Math Value (MV). The direct path from BAS to MV (Table 4) was not significant in this model ($\beta = 0.200$, $t = 1.403$, $p = .161$). Table 4 revealed that BAS is significantly associated with BAT ($\beta = 0.701$, $t = 10.907$, $p < .01$), and BAT is significantly associated with MV ($\beta = 0.433$, $t = 3.417$, $p < .01$). The indirect effect of BAS on MV through BAT (Table 5) was significant ($\beta = 0.304$, $t = 3.246$, $p < .01$), indicating that BAT mediates the relationship between BAS and MV. The results indicate that Belief about Teacher (BAT) mediates the relationship between Belief about Self (BAS) and Math Value (MV). This implies that increasing students' self-belief can improve their perceptions of their teachers, thereby increasing their appreciation for math. The direct relationship between BAS and MV was not significant, indicating that the effect of BAS on MV is completely mediated by BAT.

The results (Table 4) indicate that BAT significantly impact BAM ($\beta = 0.625$, $t = 5.915$, $p < .01$), and BAM significantly impact MV ($\beta = 0.274$, $t = 2.718$, $p < .01$). The indirect effect of BAT on MV through BAM (Table 5) was significant ($\beta = 0.171$, $t = 2.644$, $p < .01$). The direct effect of BAT on MV (Table 4) was also significant ($\beta = 0.433$, $t = 3.417$, $p < .01$), indicating partial mediation. These findings imply that a positive belief in the teacher (BAT) leads to a more positive belief in math (BAM), which leads to a higher value placed on math (MV). As a result, BAM partially mediates the interaction between BAT and MV.

A mediation analysis was conducted to determine whether BAT mediates the relationship between BAS and BAM. The direct path from BAS to BAM was not investigated in this model. BAS was significantly associated with BAT (β = 0.701, t = 10.907, p <.01). BAT was significantly associated with BAM (β = 0.625, t = 5.915, p <.01). The indirect effect of BAS on BAM through BAT (Table 5) was significant (β = 0.439, t = 5.093, p <.001), indicating that BAT mediates the relationship between BAS and BAM. The findings indicate that BAS indirectly influences BAM via BAT. This suggests that increasing students' self-belief can have a positive impact on their math beliefs by first improving their perceptions of their teachers. The direct relationship between BAS and BAM was not investigated, leaving room for future research to determine whether there is a direct effect in addition to the mediated pathway.

A serial mediation analysis was conducted to examine whether Belief about Teacher (BAT) and Belief about Math (BAM) mediate the relationship between Belief about Self (BAS) and Math Value (MV). The direct effect of BAS on MV (Table 4) was not significant (β = 0.200, t = 1.403, p =.161). The direct effects (Table 5) of BAS on BAT (β = 0.701, t = 10.907, p <.01), BAT on BAM (β = 0.625, t = 5.915, p <.01), and BAM on MV (β = 0.274, t = 2.718, p <.01) were all significant. The indirect effect of BAS on MV through BAT and BAM (Table 5) was significant (β = 0.120, t = 2.608, p <.01), indicating a significant serial mediation.

The findings indicate that Belief about Self (BAS) indirectly influences Math Value (MV) via a sequential mediation of Belief about Teacher (BAT) and Belief about Math (BAM). This suggests that increasing students' self-belief can have a positive impact on their math valuation by first improving their perceptions of their teachers and then their math beliefs. Direct interventions focusing solely on self-belief may be insufficient; a comprehensive approach that addresses multiple factors is required to foster a higher value for math.

Table 6

Moderated Mediation Effect

Path	β	t-value	p-value	Result
Gender × BAT → BAM → MV	-0.111	1.791	0.073	Not Supported

*Note. BAM = Belief About Mathematics, BAS = Belief About Self, BAT = Belief About Teacher, MV = Mathematics Value, *p < .05, **p < .01, ***p < .001*

Table 6 show the results of moderated mediation analysis, carried out to determine whether the interaction of Gender and Belief about Teacher (BAT) influences Math Value (MV) via Belief about Math (BAM). The interaction term (Gender × BAT) was added to test for moderation effects on BAM. The interaction term (Gender × BAT) did not significantly predict BAM (β = -0.111, t = 1.791, p = .073). BAM was significantly associated with MV (β = 0.274, t = 2.718, p <.01). Since the interaction term did not significantly predict BAM, the indirect effect of Gender × BAT on MV through BAM was not significant, suggesting no moderated mediation.

The findings show that the interaction of Gender and Belief about Teacher (BAT) has no significant influence on Belief about Math (BAM), and thus has no impact on Math Value (MV) via BAM. This suggests that BAT's effect on BAM and, ultimately, MV is consistent across genders, with no significant gender moderating effect.

5. Discussion and Conclusion

This study explored the associations between students' beliefs about self (BAS), beliefs about teacher (BAT), beliefs about math (BAM), and math value (MV) using Partial Least Squares Structural Equation Modeling (PLS-SEM). The findings highlighted several key paths and mediation relationships that illustrated the structural complexity of students' beliefs in mathematics education.

First, it identified that BAS contributed to statistically significant predictions of BAT. This suggested that students' beliefs about themselves, employed through their BAS, influenced their beliefs about their teacher. In other words, results demonstrated that, on average, students with higher beliefs about themselves are more likely to engage positively with others and their environment. This is aligned with self-efficacy theory (Bandura, 1977), which stated that individuals with high insight in their beliefs about their capabilities are more likely to positively and accurately ascertain information about their environment and how others interact within it. Second, previous research has also affirmed that academic self-beliefs shape students' relationships with educators (Hailikari et al., 2008; Valentine et al., 2004).

In addition, the relationships between BAM and MV and with BAT both were statistically significant, indicating that students who view their teacher as competent and supportive are more likely to see mathematics in a positive way, enhance their attitudes towards mathematics, and value the subject. These findings are consistent with Midgley et al. (1988) and Muijs and Reynolds (2002), who highlighted the impact of teacher beliefs and practice on student engagement and achievement. Alfaro and Joutsenlahti (2021) found similar findings where teacher support corresponds with stronger emotional engagement with mathematics and greater value given to math's learning.

The significant BAM → MV relationship confirms that students who perceive math as useful tend to value it more supporting expectancy-value theory (Eccles & Wigfield, 2002) where subjective task values were dependent upon the usefulness, interest, and relevance of that subject. These findings are also consistent with Gaspard et al. (2015) in that positive beliefs about mathematics increase or promote student motivation and academic performance.

Interestingly, BAS did not show a direct effect on MV, but a significant serial mediation was identified with BAT, and BAM. This indicates the impact of self-belief on the value given to mathematics is an indirect influence, with the enhancement of the student perception of the teacher, which leads to the enhancement of beliefs about that subject. These results support the findings by Skaalvik and Skaalvik (2006) and Parker et al. (2014) who indicated academic beliefs involved in educational outcomes lies in the interrelated pathways of cognition and the social which is often hard to disentangle.

Importantly, the moderated mediation effect of gender was not statistically significant which means the model pathways operate the same for male and female students. This is also consistent with the meta-analysis by Else-Quest et al. (2010) which reported very small or inconsistent gender differences in mathematics attitudes and beliefs.

This study offers an evidence to a growing research base that highlights the interrelated systems of beliefs which exist during the educational process. Furthermore, it has provided empirical support for the teacher-student relationship and the beliefs specific to subjects being important factors when trying to boost students' value of mathematics.

The study showed that students’ beliefs about their teachers and their beliefs about mathematics had a more direct impact on influencing their math value instead of just the self-beliefs. The BAS had an indirect impact on MV through the BAT and BAM, but the teachers’ actions (BAM) and the teachers' beliefs about mathematics (BAT) were the most direct predictors of MV. Therefore, it may be worth noting that building positive relationships with students and teachers, as well as building positive beliefs about the subject are not only impactful on building students' engagement and interest in mathematics, but also helps prepare them for long-term engagement in mathematics and in school, ultimately leading to deep learning and ultimately educators’ instructional goals. While these contributions are valuable, the study also has limitations. The sample was limited to private schools in District East Karachi and the generalizability of findings will be limited to this region and type of school. The cross-sectional design prohibits making causal inferences. Furthermore, as self-reported, responses may be susceptible to response bias. These constraints should be considered when interpreting findings.

In conclusion, the results indicate a need for effective teaching strategies to enhance self-esteem, develop better teacher learner relationships, and make approaching mathematics take a relevant and engaging lesson. By focusing on these kinds of areas during instruction, a teacher could help develop more positive attitudes and appreciation of mathematics, significantly increasing their students learning and outcomes.

6. Recommendations

In light of the findings and implications of the study, the following recommendations are made in order to enhance students' mathematical beliefs and perceived value of mathematics:

1. Schools may provide training to teachers on the importance of establishing respectful, trustworthy relationships with students. A teacher that displays interest in students' learning and achievement can greatly improve students' interest and value in mathematics.
2. Teachers should always connect math topics to real-life contexts (e.g., budgeting, sports statistics, or technology use). This will make math more relevant and help students think it has relevance in their daily lives.
3. Include simple strategies such as student self-assessments, measuring effort, and emphasizing attainable tasks to construct students' confidence in their capability to do math.
4. Teachers and counselors may use quick classroom surveys or check-ins to get students' feelings and beliefs about math, and help those exhibiting doubt or anxiety.
5. Teachers should keep high expectations for boys and girls in math, and limit the subtle messages that may discourage one gender or the other from participating in math.

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Citation of this Article:

Kang, M. A. (2025).Exploring the Interplay of Beliefs and Values: A PLS-SEM Investigation into Self, Teacher, and Math Beliefs, and their Impact on Math Value. *International Journal of Innovation in Teaching and Learning (IJITL)*, *11*(1), 79-96.