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Lekë Ukaj and Fatmir Mehmeti

Beliefs about mathematics and achievement among Kosovar students: Examining the mediating role of curiosity and mathematics anxiety

Abstract: This study examines the mediating roles of curiosity and mathematics anxiety in the relationship between students' beliefs about mathematics and their mathematics achievement using structural equation modelling analysis. A quantitative research design was adopted, and the data were analysed using Mplus and IBM SPSS. The representative sample comprised 6,027 Kosovar students drawn from the PISA 2022 database. The dependent variable was the mathematics scores earned by Kosovar students in PISA 2022. The independent variables include the items from the PISA 2022 Student Questionnaire: 'beliefs about mathematics' and the mediators 'curiosity' and 'anxiety'. The results revealed that strong beliefs about mathematics positively influence achievement, and curiosity also has a positive effect, whereas mathematics anxiety negatively affects achievement. Furthermore, both curiosity and anxiety mediate the relationship between beliefs about mathematics and mathematics achievement.

Keywords: mathematics achievement, anxiety, beliefs about mathematics, curiosity, PISA 2022

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Lekë Ukaj, PhD. candidate, University of Ljubljana, Faculty of Education, Kardeljeva ploščad 16, SI-1000 Ljubljana, Slovenia; e-mail: ukajleka1@gmail.com

Fatmir Mehmeti, PhD., associate professor, University "Ukshin Hoti" Prizren, Faculty of Education, Rruga e Shkronjave, nr. 1, 20000 Prizren, Kosovo; e-mail: fatmir.mehmeti@uni-prizren.com

Introduction

Succeeding in mathematics is a multifaceted endeavour shaped by emotional, psychological, and educational influences. Understanding these factors is critical for educators who seek to effectively support their students' academic achievement. Various studies (Brezavšček et al. 2020; Jiang et al. 2018) have consistently shown that psychological variables play an important role in academic success. Among the key emotional and psychological factors affecting mathematical achievement are beliefs about mathematics, curiosity, and mathematics anxiety. Beliefs are personal principles developed through experiences, which individuals often use unconsciously to interpret new information and guide their actions (Pajares 1992). They play an important role in controlling human perception and behaviour. It is widely recognised that both cognitive and affective factors, such as attitudes, beliefs, feelings, and moods, must be examined to improve our understanding of mathematics learning. Students' beliefs about mathematics education are influenced by both contextual experiences and individual psychological factors, including their needs, desires, and goals. These beliefs encompass their views on mathematics instruction, self-beliefs, and perceptions of the classroom environment (Eynde and De Corte 2003). Research has further shown that attitudes and beliefs about mathematics significantly influence mathematics achievement (Ma and Kishor 1997).

Curiosity, defined by Berlyne (1954) as the drive to explore and acquire new information, is a powerful intrinsic motivator for learning (Nurishlah et al. 2020). It promotes active learning and spontaneous exploration, driving individuals to seek new knowledge and interact deeply with learning materials. This proactive engagement improves retention and comprehension and promotes critical thinking and problem-solving skills (Oudeyer et al. 2016).

Mathematics anxiety, on the other hand, is characterised by feelings of tension and discomfort that hinder numerical manipulation and problem solving. It differs from general attitudes towards mathematics, which are influenced by motivational and cognitive factors (Dowker et al. 2016; Richardson and Suinn 1972).

Wood (1988) defined mathematics anxiety as a state of discomfort experienced when individuals are required to perform mathematical tasks. In severe cases, it can develop into a serious mental condition and lead to mathematics avoidance or even mathematics phobia (Tobias 1993). This anxiety affects both academic and everyday performance by reducing confidence and hindering cognitive processing. Consequently, it limits engagement with mathematical activities and contributes to poor results.

Wang et al. (2023) identified seven factors consistently associated with mathematics performance in PISA data across different contexts. They found positive correlations with student grade level and family socioeconomic status (SES) and negative associations with mathematics performance, namely student absenteeism and lack of punctuality, school repetition and dropout rates, student misbehaviour, teacher and staff shortages, and inadequate use of student-centred instruction. During our research, we identified a gap in the study of mathematics performance in PISA 2022 and its influencing factors specific to the Republic of Kosovo. Although PISA has been widely used to analyse mathematics performance across countries, there is limited research focusing specifically on Kosovo. Most international studies emphasise high-performing or OECD countries, while less attention is given to developing or low-performing education systems. In Kosovo, existing literature often discusses overall achievement scores without exploring how students' beliefs about mathematics, curiosity, and mathematics anxiety interact to affect performance. This gap is significant, as understanding these psychological and attitudinal factors is crucial for explaining why Kosovo consistently performs below the OECD average and for identifying strategies to improve outcomes.

However, few studies have examined psycho-emotional factors that may influence mathematics performance in PISA 2022. Mathematics anxiety, particularly, represents a significant barrier to academic achievement as it affects students' ability to perform well on mathematical activities. This anxiety provokes avoidance behaviour and hinders cognitive processes important for problem-solving. Therefore, managing and alleviating mathematics anxiety is critical for educators as it influences individual performance and broader attitudes towards mathematics in educational settings.

Literature review

Beliefs about mathematics, curiosity, and mathematics anxiety

Beliefs about mathematics – Mathematical beliefs have been extensively studied in the literature and refer to psychologically grounded assumptions about mathematics (Philipp 2007). McLeod (1992) proposed four categories of students' beliefs. The first includes beliefs about mathematics itself, such as perceptions of its difficulty or its regulation by fixed laws. The second category comprises beliefs about oneself, including attributions for mathematical success or failure and confidence in one's ability to learn the subject. The third category relates to beliefs about teaching, including views on what teachers should do to help students learn mathematics. Finally, beliefs about the social context concern the influence of parents and others outside the classroom, as well as the perception that learning mathematics is competitive.

Mathematical beliefs strongly influence how students' approach and engage with mathematical learning (Schoenfeld 1989). Grootenboer and Marshman (2016) emphasise that students with positive attitudes towards mathematics, such as confidence in their abilities and a sense of relevance of mathematics to their lives, tend to perform better academically. Conversely, negative beliefs, such as the perception that mathematics is difficult or irrelevant, can lead to lower achievement and disengagement. Ma and Kishor (1997) demonstrated through a meta-analysis study that attitudes and beliefs about mathematics affect mathematical performance

Curiosity – Curiosity involves the tendency to ask questions, investigate, and seek new knowledge. It shapes how individuals approach learning and serves as a foundation for intrinsic motivation, which is vital in education (Gurning & Siregar, 2017). Curiosity plays an essential role in knowledge acquisition, encouraging learners to explore complex concepts and persist in problem-solving (Hassinger-Das et al. 2018). It is a strong predictor of academic achievement and promotes proactive engagement with learning content (Mussel 2022). Studies have shown that curiosity is a powerful predictor of mathematical achievement (Harackiewicz et al. 2008), while its absence can be detrimental to learning outcomes (Krapp 1999). Furthermore, curiosity has been found to correlate positively with academic achievement (Banupriya and Rajan 2019).

Mathematics anxiety extends beyond a simple dislike of mathematics (Vinson 2001). Ashcraft and Kirk (2001) discovered that individuals with high mathematics anxiety have shorter working memory spans than those with low anxiety, particularly in arithmetic tasks. These individuals also tend to perform more slowly and make more errors when performing mental calculations and memorisation simultaneously. Research consistently demonstrates that mathematics anxiety negatively impacts academic performance, particularly in mathematics-related subjects.

Hembree (1990), in a meta-analysis of 151 studies, reported that mathematics anxiety was strongly correlated with poorer performance in achievement tests. It is also associated with negative attitudes towards and avoidance of mathematics. The consequences of mathematics anxiety not only affect performance in an academic context but also have long-term effects on learning efficiency, course selection, and even career choices (Luttenberger et al. 2018).

Pisa context and Kosovo

PISA context – Kosovo participated in PISA as an OECD partner for the first time in 2015, again in 2018, and most recently in 2022. As in previous cycles, PISA

2022 assessed reading, mathematics, and science, with a strong emphasis on mathematics. It also evaluated students' financial literacy and creative thinking skills.

In PISA 2022, 15-year-olds in Kosovo scored an average of 355 points in mathematics, the main subject of PISA 2022, compared with the average of 472 points in OECD countries. Only 15% of students achieved at least Level 2 proficiency, significantly below the OECD average of 69%. Without explicit guidance, these students can at least identify how simple real-life situations may be expressed mathematically. Almost no students in Kosovo achieved high proficiency (Levels 5 or 6), compared with an OECD average of 9%. At these levels, students can model complex situations mathematically and select, compare, and evaluate appropriate problem-solving strategies. Kosovo remains among the lowest-performing countries

Despite extensive international use of PISA to analyse mathematics performance, there is a lack of studies examining the impact of positive mathematical beliefs, curiosity, and mathematics anxiety on academic achievement in Kosovo. The country's education system is still developing within a post-conflict, transitional context that differs significantly from many OECD systems. Understanding how these psycho-emotional variables interact is vital for explaining persistent achievement gaps.

Cultural expectations, limited exposure to inquiry-based learning, and systemic challenges all shape students' attitudes towards mathematics in Kosovo. By situating this context within the global PISA framework, the present study offers comparative insights that are relevant for understanding both local dynamics and broader discussions on how beliefs and emotions affect learning in developing education systems. However, these relationships and their impact on PISA results remain underexplored in Kosovo, and the lack of empirical evidence limits the development of tailored interventions and educational programs aimed at improving performance among Kosovar students (OECD 2024a).

Our research identified several studies analysing Kosovo's PISA results. Shala and Grajcevci (2021) found that socioeconomic status affected student performance, while teacher feedback and support were linked to better PISA results in 2015 and 2018. Tahirsylaj (2021) observed a shift towards standardised testing in the national curriculum, and Osdautaj (2020) also investigated Kosovo's low performance. Qehaja and Aliu (2018) emphasised the importance of teacher development and resource availability for improving achievement, whereas Shala and Grajcevci (2018) again confirmed the impact of socioeconomic factors.

Totaj and Mehmeti (2024) explored relationships between reading engagement, enjoyment, perceived competence, perceived difficulty, and reading achievement in PISA 2018. Their study revealed that, although teacher stimulation of reading engagement had a relatively weak impact on reading achievement, factors such as reading enjoyment and perceived reading competence were significantly associated with higher performance. Conversely, perceived difficulty in reading had a negative effect on students' reading scores. The authors concluded that fostering a positive reading environment, enhancing students' confidence in their reading abilities, and addressing perceived reading challenges are crucial strategies for improving literacy and reading achievement in Kosovo. Shala and Grajcevci (2023) investigated the impact of Information and Communication Technology (ICT) on Kosovar students' PISA 2018 performance, reporting that access to computers and technology was linked with better results in reading literacy, mathematics, and science. However, most students used ICT primarily for entertainment. Additionally, although female students reported lower usage of ICT, they outperformed male students in reading literacy and science. The study underscores the need for educational policies that not only provide access to ICT resources but also ensure their effective use for learning to address achievement gaps and promote equity in education.

Collectively, these studies examine contextual and socioeconomic factors; however, little research has focused on psychological variables influencing mathematics achievement. This study, therefore, aims to fill that gap by examining the relationship between beliefs about mathematics and mathematics achievement through the mediating roles of curiosity and mathematics anxiety within the Kosovar context.

This research contributes to initiatives aimed at improving educational outcomes by offering insights into psycho-emotional factors affecting students' mathematics achievement. The following hypotheses were tested:

- H1: Beliefs about mathematics positively affect mathematics achievement (PVMATH).
- H2: Beliefs about mathematics positively affect curiosity.
- H3: Beliefs about mathematics negatively affect anxiety.
- H4: Curiosity negatively affects anxiety.
- H5: Curiosity positively affects mathematics achievement (PVMATH).
- H6: Anxiety negatively affects mathematics achievement (PVMATH).
- H7: Beliefs about mathematics influence mathematics achievement through curiosity as a mediating factor.
- H8: Beliefs about mathematics influence mathematics achievement through anxiety as a mediating factor.
- H9: Beliefs about mathematics influence mathematics achievement through the sequential mediation of curiosity and anxiety.

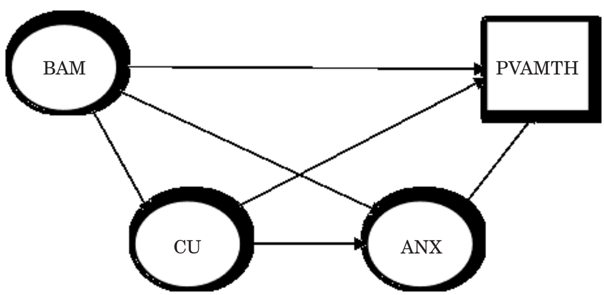

Figure 1: Hypothetical serial model representing the relationships between the constructs.
Note: BAM= Beliefs about mathematics; CU=Curiosity; ANX= Anxiety; PVMATH=Mathematics achievement

Methodology

This study employed a quantitative, descriptive, cross-sectional research design using data from the PISA 2022 dataset for Kosovar students. The analysis examined the relationships between students' beliefs about mathematics, their achievement, and the mediating roles of curiosity and mathematics anxiety. Structural Equation Modelling (SEM) was applied as the primary analytical method, as it enables simultaneous estimation of direct and indirect effects among variables and provides a robust assessment of the hypothesised mediation model. Data were processed in accordance with established PISA procedures to ensure reliability and comparability with international standards.

The MODEL CONSTRAINT section was used to analyse indirect effects. Standardised coefficients (*STANDARDIZED*) were required in the Mplus output to better interpret relationships between variables. The TECH1, TECH4, and TECH5 options were activated to obtain detailed information on model architecture and to identify opportunities for improvement. Confidence intervals (*CINTERVALS*) were used to evaluate the accuracy of parameter estimates. This approach enabled testing of both direct relationships among variables and the mediating roles of curiosity and anxiety in the effect of beliefs on mathematical achievement, offering a deeper understanding of their interactions.

Sample

The representative sample for this study comprised 6,027 students (3,928 girls and 3,099 boys) from 229 schools across Kosovo. This sample represents approximately 21,000 15-year-old students in the country. Students ranged from Grades 8 to 12, reflecting diverse educational experiences and levels of academic maturity. Data for this analysis were drawn from the PISA 2022 database.

Data collection tool and procedure

Mplus version 8.11 was used for statistical analysis. This software is particularly suited for SEM, as it allows estimation of complex models with latent variables, mediation effects, and multiple interrelated pathways. The dependent variable was the mathematics achievement, measured by the points earned by Kosovar students in PISA 2022. The independent variables were drawn from the PISA 2022 student questionnaire, specifically the constructs *beliefs about mathematics*, *curiosity*, and *mathematics anxiety*.

The latent variable *beliefs about mathematics* was constructed from three items: *Mathematics is one of my favourite subjects*; *Mathematics is easy for me*; *I want to do well in my mathematics class*. Each item had four response options: *strongly agree*, *agree*, *disagree*, and *strongly disagree* (OECD 2021; OECD 2024b).

The composite reliability (ω) for this construct was approximately .79, indicating good internal consistency and reliability of measurement.

The latent variable *curiosity* was derived from ten items: *I am curious about many different things; I like to ask questions*; *I get frustrated when I have to learn the details of a topic*; *I like to know how things work; I love learning new things in school; I am more curious than most people I know; I like to develop hypotheses and check them based on what I observe*; *I find learning new things to be boring*; *I spend time finding more information about things that interest me*; *I like learning new things*. Responses were provided on a five-point scale (*strongly disagree*, *disagree*, *neither agree nor disagree*, *agree*, and *strongly agree*) (OECD 2021; OECD 2024b). The composite reliability (ω) for curiosity was approximately .89.

The latent variable *mathematics anxiety* comprised six items: *I often worry that it will be difficult for me in mathematics classes; I get very tense when I have to do mathematics homework; I get very nervous doing mathematics problems; I feel helpless when doing a mathematics problem; I worry that I will perform poorly in mathematics; I feel anxious about failing in mathematics*. Each item had four response options (*strongly agree*, *agree*, *disagree*, and *strongly disagree*) (OECD 2021; OECD 2024b). The composite reliability (ω) for mathematics anxiety was approximately .86.

Data processing statistical methods

The methodology involved several key steps for data processing, analysis, and interpretation of the results. Missing data were handled using IBM SPSS (Version 27) statistical program, where absent values were re-encoded as *–999* to clearly identify them and facilitate imputation. Mplus (Version 8.11) was then used to handle missing data through imputation and to estimate the structural models. This approach ensures reliability and completeness of analysis.

First, a confirmatory factor analysis (CFA) was conducted to assess the factorial structure of the instruments and to validate the measurement model. Latent variables were generated to represent the theoretical constructs under investigation. After establishing the factor structure, correlation analysis was performed to examine relationships among the latent variables

Subsequently, a structural model was developed to test the hypothesised relationships and the mediating roles of curiosity and mathematics anxiety. The model included three latent variables: beliefs about mathematics (independent), curiosity and mathematics anxiety (mediators), and one dependent variable, mathematics achievement.

In the initial CFA, several items showed weak factor loadings and were excluded to improve model fit. Specifically, the following were removed:

From *beliefs about mathematics*: *I want to do well in my mathematics class* with a loading of .415.

From *curiosity*: *I get frustrated when I have to learn the details of topics* with a loading of −.382; *I like to develop hypotheses and check them based on what I* *observe* with a loading of .576; *I find learning new things to be boring* with a loading of .029.

From *mathematics anxiety*: *I often worry that it will be difficult for me in mathematics classes* with a loading of .646.

The first CFA produced the following model fit indices: χ^2 (165) = 2417.537, chi-square to degree of freedom ratio (χ^2/df) = 14.651, comparative fit index (CFI) = .892, Tucker–Lewis index (TLI) = .876, standardized root mean squared residual (SRMR) = .063, and root mean square error of approximation (RMSEA) = .048. While the CFI and TLI values approached the acceptable threshold (≥ .90), the χ^2/df ratio indicated poor fit. However, SRMR and RMSEA values suggested an acceptable, though improvable, fit. After removing poorly performing items, a second CFA was conducted, which demonstrated substantial improvements in fit indices: χ^2 (75) = 769.095, χ^2/df = 10.254, CFI = .957, TLI = .948, SRMR = .036, and RMSEA = .042. Both CFI and TLI exceeded the recommended threshold of .95, indicating strong model fit, whereas RMSEA and SRMR were well within acceptable limits. Table 1 presents fit indices for both analyses. Figure 2 presents the CFA model with latent variables and their observed indicators.

	χ2	df	χ2/df	CFI	TLI	SRMR	RMSEA
First confirmatory factorial analysis	2417.537	165	14.651	.892	.876	.063	.048
Second confirmatory factorial analysis	769.095	75	10.2546	.957	.948	.036	.042

Table 1: Model fit indices.

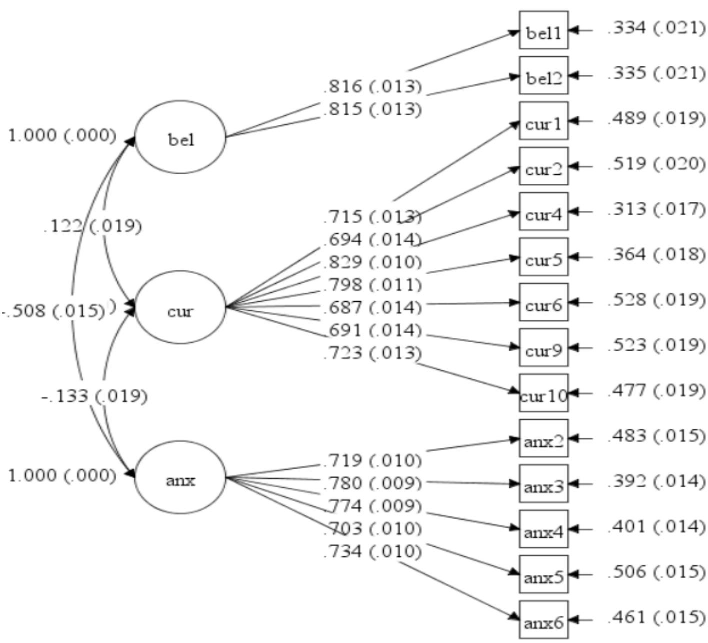

Figure 2: Confirmatory factor analysis.
Note. bel— Beliefs about mathematics; cur—Curiosity; anx— Anxiety

Results

After performing a CFA to assess the model's suitability, a correlation analysis was conducted to explore relationships among the study variables. The results are presented in Table 2, which summarises correlations between the constructs and their indicators, providing a clearer understanding of their interdependencies.

	Beliefs	Curiosity	Anxiety
1. Beliefs about mathematics	1		
2. Curiosity	.138**	1	
3. Anxiety	−.021**	−.149**	1
4. PVMATH	.162**	.228**	−.208**

Table 2: Correlations among beliefs about mathematics, curiosity, anxiety, and mathematics achievement (PVMATH).

The analysis revealed a significant positive correlation between beliefs about mathematics and curiosity ($r = .138$, $p < .01$), indicating that students with stronger mathematical beliefs tend to demonstrate greater curiosity in learning mathematics. Anxiety was negatively correlated with both beliefs about mathematics ($r = -.021$, $p < .01$) and curiosity ($r = -.149$, $p < .01$), suggesting that higher anxiety levels are associated with weaker confidence in mathematical ability and reduced curiosity. A significant positive correlation was also observed between beliefs about mathematics and mathematics achievement (PVMATH) ($r = .162$, $p < .01$), implying that students with stronger beliefs in their mathematical competence perform better in the subject. Similarly, curiosity showed a significant positive correlation with mathematics achievement ($r = .228$, $p < .01$), indicating that students who exhibit greater curiosity in learning mathematics achieve higher academic performance. By contrast, anxiety showed a negative correlation with mathematics achievement ($r = -.208$, $p < .01$), confirming that students with higher anxiety levels tend to perform less well in mathematics

The hypothesis testing results from the SEM analysis (see Figure 3) provide deeper insights into the relationships among beliefs about mathematics, curiosity, anxiety, and mathematics achievement in PISA (PVMATH). The standardised estimates, confidence intervals, and p-values for each hypothesis are summarised in Table 3.

H:	**Hypotheses Test**	**Std. Estimate**	**Lower Bound**	**Upper Bound**	**p-value**
H1:	Beliefs → PVMATH	.119	6.045	11.429	.000
H2:	Beliefs → Curiosity	.119	.098	.167	.000
H3:	Beliefs → Anxiety	−.495	−.416	−.361	.000
H4:	Curiosity → Anxiety	−.071	−.071	−.030	.000

H5:	*Curiosity → PVMATH*	*.188*	*10.474*	*14.465*	*.000*
H6:	Anxiety → PVMATH	−.164	−18.590	−12.138	.000
H7:	Beliefs → Curiosity. → PVMATH	.022	1.160	2.226	.000
H8:	Beliefs → Anxiety → PVMATH	.081	4.672	7.262	.000
H9:	Beliefs→ Curiosity→ Anxiety → PVMATH	.076	.086	.124	.001

Table 3: Hypotheses analysis results.

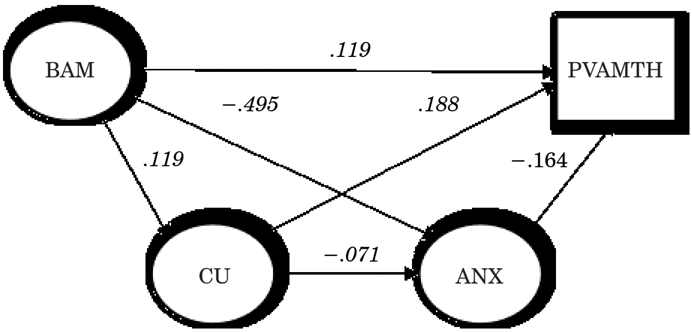

Figure 3: Structural equation model depicting the serial mediation among beliefs, curiosity, anxiety, and mathematics achievement.

Note:. BAM— Beliefs about mathematics; CU—Curiosity; ANX— Anxiety; PVMATH – Mathematics achievement

A significant positive effect of beliefs about mathematics on mathematics achievement was observed ($\beta = .119$, $p < .001$), indicating that students with stronger mathematical beliefs tend to perform better. Beliefs about mathematics also had a positive effect on curiosity ($\beta = .119$, $p < .001$), suggesting that confident students show greater interest in learning. Conversely, a negative relationship was found between beliefs about mathematics and anxiety ($\beta = -.495$, $p < .001$), implying that stronger beliefs correspond to lower anxiety levels. Curiosity was negatively related to anxiety ($\beta = -.071$, $p < .001$), indicating that higher curiosity is associated with reduced anxiety in mathematics learning. Curiosity also exerted a significant positive effect on mathematics achievement ($\beta = .188$, $p < .001$), indicating that more curious students tend to perform better academically. By contrast, anxiety had a significant negative effect on mathematics achievement ($\beta = -.164$, $p < .001$), confirming that higher anxiety levels hinder performance. Beliefs about mathematics influenced mathematics achievement indirectly through curiosity ($\beta = .022$, $p < .001$), suggesting that curiosity mediates this relationship. Similarly, beliefs affected achievement indirectly through anxiety ($\beta = .081$, $p < .001$), indicating that lower anxiety enhances performance. A significant indirect impact was observed for beliefs about mathematics on mathematics achievement through the combined pathway of curiosity and anxiety ($\beta = .076$, $p = .001$). These findings highlight the complex interplay among cognitive, affective, and motivational factors in determining students' mathematics performance.

Discussion

The aim of this study was to examine the impact of beliefs about mathematics on PISA mathematics performance among students in Kosovo, considering the mediating roles of curiosity and mathematics anxiety. By exploring how these factors interact, the study provides insights into the psychological and emotional determinants of students' mathematics achievement. The results revealed significant correlations among beliefs about mathematics, curiosity, mathematics anxiety, and academic achievement, offering important insights into student performance. Both beliefs about mathematics and curiosity were positively correlated with achievement, indicating that students who are confident and curious tend to perform better academically (Hwang and Son 2021; Wild and Neef 2023). Conversely, mathematics anxiety showed a negative association with both beliefs and achievement, underscoring its detrimental impact on performance (Hui et al. 2020). These findings confirm that fostering positive beliefs, encouraging curiosity, and reducing anxiety are key to improving mathematics achievement.

To better understand how these factors interact with each other and influence student success, the SEM analysis was used to assess both direct and mediating effects. The findings demonstrated that beliefs about mathematics exerted a significant positive influence on students' success and curiosity and a negative influence on mathematics anxiety. This aligns with previous studies highlighting the central role of beliefs about mathematics on academic achievement (Ma and Kishor 1997). High self-confidence functions as a powerful motivator that enhances students' engagement with mathematical tasks (Michaelides et al. 2019). Students who believe in their abilities are more likely to participate actively in class, ask questions, practise consistently, and strive to understand new concepts (Doménech-Betoret et al. 2017). Confidence not only boosts persistence but also enables students to demonstrate their skills and knowledge more effectively in assessments (Talsma et al. 2018).

Curiosity has a positive impact on students' success in mathematics and a negative effect on mathematics anxiety. High curiosity can serve as a protective factor against anxiety by helping students focus on the positive aspects of learning and exploring concepts rather than the fear of failure. In this way, curiosity transforms anxiety from an obstacle into a challenge that can be overcome (Grossnickle 2016). It can also enhance self-confidence and promote a more active learning approach, allowing students to use anxiety as motivation for success. Teachers can help reduce the negative effects of anxiety by encouraging students' curiosity. Creating a classroom environment that encourages exploration, questioning, and active engagement can help students concentrate on learning mathematics rather than fearing failure (Nguyen et al. 2021). Such an environment supports better performance, even among students who experience high levels of anxiety.

Curiosity is a powerful motivator that drives students to explore, learn, and understand academic material more deeply (Renninger and Hidi 2019). Curious students are typically self-directed learners who go beyond what is taught in class and willingly engage with complex challenges (Grossnickle 2016). To enhance mathematical success, teachers should cultivate environments that stimulate and sustain curiosity through questioning, exploration of new ideas, and the practical application of mathematical concepts in real-world situations. Materials and assignments designed to spark interest can further encourage creative and critical thinking (Park et al. 2021).

By contrast, mathematics anxiety has a significant negative impact on students' success in mathematics. It is a well-documented problem that undermines learning outcomes (Zhao et al. 2019). Students with high anxiety often feel overwhelmed by mathematical tasks, leading to avoidance, poor concentration, and low confidence (Daker et al. 2021). This negative cycle can hinder their ability to effectively understand and solve mathematical problems (Foley et al. 2017). Teachers should therefore develop strategies to help students manage and reduce anxiety through stress-management techniques, effective study methods, and supportive and nonjudgmental classroom environments (Pritchard and Wilson 2003). Encouraging help-seeking behaviour and providing emotional support are also important steps in reducing anxiety's negative effects.

Curiosity also plays a mediating role between beliefs about mathematics and achievement. When combined with positive beliefs, the influence of curiosity on success becomes even stronger (Peterson and Cohen 2019). Students who value mathematics are more likely to be curious about it (Schukajlow et al. 2012), and that curiosity deepens understanding of concepts and engagement. This mediation process enhances achievement and motivates students to go beyond minimal requirements. Teachers should focus on creating an environment that promotes positive views about mathematics and stimulates students' curiosity. Such teaching methods make mathematics interesting and relevant to students' everyday experiences. Creating a classroom atmosphere that encourages questioning and discussion can help increase students' curiosity, thereby improving the outcomes of mathematics assessments.

Although mathematics anxiety has a negative effect when viewed independently, it can have a positive mediating role between beliefs about mathematics and achievement. Strong positive beliefs can buffer the adverse impact of anxiety. Students who believe mathematics is important and that they can master it are better equipped to handle stress and pressure (Luu-Thi et al. 2021). Teachers can strengthen these beliefs by connecting mathematics to real-life applications and engaging students in meaningful learning activities. They should also provide emotional support and strategies to build confidence and reduce stress (Salter et al. 2024).

When curiosity and anxiety interact as mediators, their combined influence reinforces the idea that a comprehensive approach—one that promotes positive beliefs, encourages curiosity, and manages anxiety—is essential to improving mathematics performance. Positive beliefs provide a foundation for self-confidence, curiosity fuels the desire to learn, and anxiety management prevents negative outcomes that hinder success. Teachers should therefore address all three aspects by promoting positive attitudes toward mathematics, encouraging exploration, and offering support for stress management. This holistic approach can help students realize their full potential in mathematics.

Conclusion

The SEM analysis confirms that a comprehensive approach integrating positive beliefs about mathematics, curiosity, and anxiety management is essential for improving student performance. While each of these factors plays an important role individually, their combined mediating effects produce a stronger positive effect on achievement. These findings emphasise the need for learning environments that not only promote positivity and curiosity in students but also address and manage the negative effects of anxiety.

Declaration of conflicting interests

The authors report there are no competing interests to declare.

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Language Editing Statement

To enhance the clarity, coherence, and overall linguistic quality of this manuscript, we utilised Grammarly and InstaText software tools. These platforms were employed to refine grammar, syntax, punctuation, and academic tone. While the content and scientific integrity remain the sole responsibility of the authors, the use of these tools contributed to improving the readability and formal expression of the text.

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Lekë UKAJ (Univerza Ljubljani, Pedagoška fakulteta, Slovenija)
Fatmir MEHMETI (Univerza "Ukshin Hoti", Pedagoška fakulteta, Kosovo)

PREPRIČANJA O MATEMATIKI IN DOSEŽKI MED KOSOVSKIMI UČENCI: PROUČEVANJE MEDIATORSKE VLOGE RADOVEDNOSTI IN MATEMATIČNE TESNOBE

Povzetek: Članek obravnava mediatorsko vlogo radovednosti in matematične tesnobe v odnosu med prepričanji učencev o matematiki in njihovimi dosežki pri matematiki z uporabo analize modeliranja strukturnih enačb. Uporabili smo kvantitativni raziskovalni pristop, podatke pa smo analizirali s programoma Mplus in IBM SPSS. Reprezentativni vzorec je obsegal 6027 kosovskih učencev iz baze podatkov PISA 2022. Za odvisno spremenljivko so bili uporabljeni rezultati kosovskih učencev iz matematike v raziskavi PISA 2022. Neodvisne spremenljivke so postavke iz vprašalnika za učence PISA 2022: »prepričanja o matematiki« ter mediatorja »radovednost« in »tesnoba«. Rezultati so pokazali, da močna prepričanja o matematiki pozitivno vplivajo na dosežke, prav tako pa ima pozitiven učinek tudi radovednost, medtem ko matematična tesnoba negativno vpliva na dosežke. Poleg tega sta tako radovednost kot tudi tesnoba mediatorja odnosa med prepričanji o matematiki in dosežki pri matematiki.

Ključne besede: dosežki pri matematiki, tesnoba, prepričanja o matematiki, radovednost, PISA 2022

Elektronski naslov: fatmir.mehmeti@uni-prizren.com