An Analysis of the Correlation Among Mathematics Teacher Support, Mathematics Anxiety, Effort and Persistence in Mathematics

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Abstract: This study aims to explore the correlations among Mathematics Teacher Support (MTS), Mathematics Anxiety (MA), and Effort and Persistence in Mathematics (EPM). Using students in France as the sample, the study processed 4,731 valid data points for MTS, 4,368 valid data points for MA, and 4,356 valid data points for EPM through methods including descriptive statistical analysis, normality test, and Spearman correlation analysis. The results showed that none of the three variables conformed to a normal distribution. Specifically, MTS was significantly negatively correlated with MA ($r=-0.129$, $p<0.01$), MTS was significantly positively correlated with EPM ($r=0.231$, $p<0.01$), and MA was significantly negatively correlated with EPM ($r=-0.105$, $p<0.01$). The study reveals the positive role of teacher support in alleviating students' mathematics anxiety and enhancing their learning effort and persistence, providing empirical evidence for optimizing teacher support strategies and improving students' learning experience in mathematics education. Meanwhile, it points out limitations such as limited sample representativeness and cross-sectional research design, as well as directions for future research.

Keywords: Mathematics Education; Mathematics Teacher Support; Mathematics Anxiety; Effort and Persistence in Mathematics; Correlation Analysis

1 Introduction

1.1 Research background

Mathematics, as a foundational discipline that underpins logical reasoning, quantitative literacy, and problem-solving skills, exerts a profound and long-lasting influence on students' academic trajectories—from primary school math proficiency to higher education performance in technical fields—and shapes their future career paths, particularly in science, technology, engineering, and mathematics (STEM) domains [1]. Wang (2013) further emphasized that mathematics learning in early and middle education stages lays the groundwork for students' access to advanced STEM courses and occupations, noting that inadequate math skills often act as a barrier to entering high-demand STEM careers such as engineering, computer science, and data analysis [1]. However, mathematics anxiety (MA)—defined as a persistent feeling of discomfort, fear, or aversion triggered by math-related tasks or situations [2]—emerges as one of the most critical factors undermining effective mathematics learning. Research indicates that MA can manifest as early as the primary school stage, often coinciding with the introduction of more complex arithmetic concepts (e.g., fractions, multi-digit multiplication), and tends to intensify with age if unaddressed, as students accumulate negative experiences with math assessments or challenging tasks [3]. Dowker et al. (2016) also highlighted that MA is not merely a transient emotional response but a chronic issue that can persist into adolescence and adulthood, affecting both academic and professional decision-making [3].

The adverse impacts of MA extend far beyond emotional distress: it is strongly negatively correlated with mathematics achievement, with studies showing that students with high MA tend to score significantly lower on math tests, quizzes, and standardized assessments compared to their peers with low MA [4]. A meta-analysis by Barroso et al. (2021) involving over 400,000 students across different age groups confirmed this robust negative relationship, noting that the strength of the correlation increases with grade level, particularly during the transition to middle school [4]. Beyond achievement, MA may also limit students' ability to utilize available mathematical resources—such as tutoring services, online learning tools, or peer study groups—because anxiety often leads to avoidance behaviors, where students deliberately avoid engaging with math-related support systems to reduce feelings of discomfort [5]. Buelow and Barnhart (2017) further found that MA is associated with impaired working memory during math tasks, which hinders students' ability to process and apply mathematical concepts even when they have access to helpful resources [5]. Most notably, MA can have long-term career implications: it may deter students from pursuing STEM-related majors and occupations, as individuals with high MA often report feeling unconfident in their ability to succeed in math-intensive fields, even if they possess the necessary academic qualifications [6]. Wang and Degol (2017) argued that this "STEM avoidance" driven by MA contributes to the persistent gender and diversity gaps in STEM industries, as MA is disproportionately prevalent among female students and underrepresented minority groups [6].

Against the backdrop of MA's detrimental effects, teacher support emerges as a crucial protective factor and guarantee for students to achieve academic success in mathematics. Teacher support is a multi-dimensional construct that encompasses cognitive support (e.g., providing clear explanations of math concepts, offering targeted feedback on problem-solving strategies), emotional support (e.g., validating students' feelings of frustration, encouraging persistence during difficult tasks), and autonomy support (e.g., allowing students to choose between math activities, fostering self-directed learning) [7]. Luo et al. (2024) clarified that these three dimensions are not mutually exclusive but work in tandem to create a supportive learning environment that addresses both the academic and emotional needs of students [7]. Numerous empirical studies have demonstrated the wide-ranging benefits of teacher support for mathematics learning: it can promote students' in-depth learning—defined as the ability to understand, connect, and apply math concepts rather than merely memorize procedures—by encouraging critical thinking and inquiry [8]. Zhao and Qin (2021) found that students who perceive high levels of teacher autonomy support are more likely to engage in deep learning strategies, such as asking questions, seeking alternative solutions, and reflecting on their mistakes, compared to students with low perceived support [8].

Additionally, teacher support can increase students' enjoyment of mathematics learning, a key predictor of long-term engagement and persistence. Choi and Cho (2021) conducted a study with middle school students and found that perceived teacher support—particularly emotional support—was positively associated with math learning enjoyment, which in turn mediated the relationship between support and academic effort [9]. Teacher support also enhances students' creativity in mathematics, as supportive teachers are more likely to encourage risk-taking, explore non-traditional problem-solving methods, and validate diverse approaches to math tasks [10]. Zhang et al. (2020) noted that primary school students who received high levels of teacher support demonstrated greater creative thinking in math, such as generating multiple solutions to a single problem or applying math concepts to real-world scenarios [10]. Furthermore, teacher support improves classroom participation: students who feel supported by their teachers are more likely to raise their hands, contribute to group discussions, and volunteer to solve math problems on the board, as they perceive the classroom as a safe space to make mistakes [11]. Wang et al. (2017) also found that teacher autonomy support, in particular, increases students' sense of ownership over their learning, which motivates them to participate more actively in class activities [11]. Finally, teacher support directly contributes to higher mathematics achievement: Yang et al. (2021) found that teacher emotional support predicts math performance through a chain of mediating factors, including increased academic self-efficacy and greater behavioral engagement in math class [12].

A notable study by Luo et al. (2024) further highlighted the specific link between teacher support, mathematics attitudes, and MA: their research with primary school students revealed that teacher support has a close, bidirectional relationship with students' math attitudes, and a strong negative association with MA. Specifically, students who perceive more teacher support (across cognitive, emotional, and autonomy dimensions) tend to develop more positive attitudes toward mathematics—such as viewing math as useful, interesting, and achievable—and report significantly lower levels of MA compared to students who feel less supported [7]. Luo et al. (2024) also noted that this relationship is particularly pronounced for students in early primary school, suggesting that early teacher support may be critical for preventing the development of chronic MA [7].

In addition to teacher support, mathematics self-efficacy (MSE)—defined as an individual's confidence in their ability to successfully complete specific math tasks, master math concepts, and achieve learning objectives in mathematics [13]—is another significant factor influencing mathematics learning. Hackett and Betz (1989) developed the Mathematics Self-Efficacy Scale, which measures MSE across different task domains (e.g., basic arithmetic, algebra, problem-solving), and their work established MSE as a distinct construct from general self-efficacy or math ability [13]. Research consistently shows that students with high MSE display greater interest in mathematics learning, participate more actively in math-related activities (e.g., extracurricular math clubs, competitions), and achieve higher scores on math assessments compared to students with low MSE [14]. Arens et al. (2020) conducted a longitudinal study with secondary school students and found that MSE at the start of the school year predicted both math interest and achievement at the end of the year, even after controlling for prior achievement and general academic self-concept [14].

Crucially, MSE is strongly negatively related to MA: students with high confidence in their math abilities are less likely to experience anxiety when faced with challenging math tasks, as they believe they have the skills to overcome difficulties [15]. Macmull and Ashkenazi (2019) explored the relationship between parenting style, MSE, and MA, finding that supportive parenting practices (e.g., encouraging math effort, avoiding negative comments about math) boost MSE, which in turn reduces MA [15]. This suggests that MSE may act as a protective buffer against the development of MA, highlighting the importance of fostering MSE in mathematics education.

Additionally, gender emerges as a key demographic factor that may influence students' perception of teacher support, mathematics attitudes, and MA. Geary et al. (2019) found that female students are more likely to report higher levels of MA than male students, even when controlling for math ability and achievement, and they often perceive less teacher support for their math learning—particularly in terms of feedback and encouragement [16]. Geary et al. (2019) attributed these gender differences to a combination of societal stereotypes (e.g., "girls are not good at math") and differential treatment by teachers, though they noted that the magnitude of these differences varies by cultural context [16]. Interestingly, some studies have found that girls perform better than boys in mathematics achievement during the primary school period, despite higher levels of MA. Arroyo-Barrigüete et al. (2023) conducted a study with students in a Spanish business school and found that female students outperformed male students in primary school math, a trend that reversed in secondary school and higher education [17]. Arroyo-Barrigüete et al. (2023) suggested that this reversal may be linked to increasing MA among girls during adolescence, as well as societal pressures that discourage girls from pursuing advanced math courses [17]. Together, these findings highlight the complexity of factors influencing mathematics learning and underscore the need to address teacher support, MSE, MA, and gender differences in a holistic manner.

1.2 Research Gap

Previous studies have identified the impacts of teacher support, MA, and math self-efficacy on math learning, yet research gaps persist. First, most studies only examine mediating role of correlations among these factors, especially those between MA and teacher support [18]. Second, related research is mainly cross-sectional, failing to reveal the developmental dynamics of factor relationships [19]. Additionally, the long-term influence mechanism of how teacher support and math self-efficacy jointly affect math achievement, particularly in primary school [20], needs exploration.

1.3 Research Question

How does MA affect students' effort and persistence in mathematics (EPM)?

How does MA influence math teacher support (MTS)?

How does MTS impact students' EPM?

1.4 Significance of the study

This study holds significant theoretical and practical value. Theoretically, it contributes to a deeper understanding of the complex relationships among factors such as teacher support, MA, and math self-efficacy, as well as their impact mechanisms on math learning, providing empirical support for the development of relevant theories (Pekrun, 2006). Practically, the research findings can offer targeted instructional suggestions for educators, assisting teachers in better understanding students' needs and providing effective support, thereby reducing students' MA and enhancing their math achievement.

2 Literature Review

2.1 The Definition

MA is described as the discomfort states including fear, aversion, etc. when individuals encounter mathematical problems [2]. It's a common negative cognitive academic emotion among children and adolescents. It relates to poor academic results [21] and impacts individuals' STEM-related career inclination. Studies indicate that mathematical anxiety emerges in early primary school and intensifies with age [22].

Teacher support is one of the most important forms of social relationships that students form and maintain in school [23]. It includes cognitive support, emotional support, and autonomy support in students' academic activities, and has an important impact on students' academic emotions and performance [24].

Effort and Persistence in Mathematics (EPM) refers to students' behavior and attitude in investing energy, concentrating, and persisting in not giving up and pursuing learning goals when facing math-learning difficulties [25]. It includes students' enthusiasm for participating in math activities, time and effort in problem-solving, and perseverance when encountering setbacks.

2.2 The Research of Mathematics Anxiety (MA) and Mathematics Teacher Support (MTS)

Numerous studies have demonstrated the close connection between teacher support and students' mathematical anxiety. Luo et al. (2024) found a significant negative correlation; more perceived teacher support leads to lower mathematical anxiety levels [7]. Yıldırım (2012) also confirmed this, noting that supported students have more confidence and security in math learning, reducing anxiety [26]. Wang et al. (2021) further emphasized the positive role of teacher support in math learning, acting as a positive influence on the learning experience and moderating mathematical anxiety [27].

According to social cognitive theory, support from others can enhance self-efficacy [28]. In math learning, MTS is positively correlated with students' math self-efficacy (MSE) [29]. MSE is significantly negatively correlated with MA [30]. For instance, Wang et al. (2023) showed that students with higher MSE are more confident in math tasks and better handle challenges, reducing anxiety [30]. Thus, teacher support may reduce MA by enhancing MSE, and this relationship has been verified in various cultural backgrounds. For example, Asian students with relatively low

MSE and high MA highlight the importance of improving MSE to alleviate anxiety [31].

2.3 The Bidirection Influence of Mathematics Anxiety (MA) and Effort and Persistence in Mathematics (EPM)

Research shows that MA negatively affects students' EPM learning. Hembree (1990) noted that it makes students feel nervous and fearful during math tasks, reducing their active learning willingness and effort [32]. High-anxiety students may avoid math-related activities and resist math learning, struggling to maintain long-term effort and persistence in learning, which has been confirmed by many studies [2]. Mathematical anxiety not only influences current learning behaviors but also negatively impacts long-term learning attitudes and habits, creating a vicious cycle that weakens EPM learning.

Although MA may hinder students' EPM, some research found that students' EPM learning can inversely affect MA. Actively engaged students with high effort and persistence may gain more math confidence and reduce MA as they progress [33]. This shows that students' learning behaviors and attitudes can regulate their math emotional experience. Through continuous effort, students may overcome MA-related obstacles and improve their learning state, though this process may be affected by multiple factors [22].

3 Method

3.1 Sample

The data comes from Moodle in the website of Lingnan University, and the data sample focus on France. Data acquisition connection is https://lms.ln.edu.hk/mod/folder/view.php?id=744568.

In terms of the number of cases, regarding three variables, MTS, MA, and effort and EPM, there are valid data 4,731, 4,368, and 4,356 respectively, and missing data are 669, 1,032 and 1,044 respectively.

Table 1. The Number of Cases

The Number of Cases			
	Mathematics Teacher Support (MTS)	Mathematics Anxiety (MA)	Effort and Persistence in Mathematics (EPM)
Valid	4731	4368	4356
Missing Value	669	1032	1044

3.2 Measures

First, descriptive analysis was utilized to obtain a preliminary overall understanding of the three variables. Next, histograms with curves, the Kolmogorov-Smirnov test (K-S), and the Shapiro-Wilk test (S-W) were adopted to check if the variables follow a normal distribution. In both the tests, when the p-value is over 0.05, the data is considered to be normally distributed; when the p-value is less than 0.05, the data is regarded as not being normally distributed. Finally, based on whether the data complies with a normal distribution, a decision was made between Pearson correlation analysis and Spearman correlation analysis.

For the correlation of each pair of variables, Spearman was computed. These coefficients fall within the range from -1 to 1. A value of -1 represents a negative unidirectional relationship, 1 stands for a positive relationship monotonically, and 0 implies no relationship. The significance of the Spearman was examined through the appropriate statistical tests. The resultant correlation coefficients together with their associated p-values were reported. A significance level of 0.01 was adopted to control for potential errors due to multiple testing [34].

3.3 Data analysis strategies

3.3.1 Descriptive Statistical Analysis

This analysis was first applied to the aim of summarizing the main features of the data. For the measurement values of each variable, related parameters will be evaluated, including mean, median, mode, SD, variance, kurtosis, and skewness. These descriptive statistics present the overall central tendency and dispersion of the data, which is helpful for the initial understanding of the sample characteristics.

3.3.2 Test of Normality

To ensure the suitability of parametric statistical tests, normality tests were conducted on the data. For the variables, the values of mean, SD, and histogram was plotted to visually inspect the distribution, which shows some kurtosis and skewness. To formally test for normality, both the K-S test and the S-W test are applied.

3.3.3 Correlation Analysis

Since the data variables did not conform to a normal distribution, as determined by the normality tests, Spearman's rank-order correlation analysis was employed instead of Pearson's correlation. Spearman's correlation is a non-parametric measure of rank correlation, which is suitable for analyzing the relationships between variables without the assumption of normality.

4 Results

4.1 Descriptive Statistical Analysis

The mean, median, and mode of three variables are displayed below in Table 2. These data shows that in terms of MTS and the EPM, the data distribution is biased towards negative values, while MA is biased towards positive values. Meanwhile, there is a large difference among the three values of measurement, indicating that the data may not follow a normal distribution. In terms of dispersion, the SD and variance are also presented below. It clearly indicates that the data dispersion of MA is relatively large, while that of the degree of EPM is relatively small. When it comes to the distribution shape, These values further verify the speculation regarding the data distribution shape, suggesting that the data deviate from the normal distribution.

Table 2. Statistic of Central Tendency

Frequency: Statistic of Central Tendency			
	MTS	MA	EPM
Mean	-0.263671	0.144817	-0.226766
Median	-0.228612	0.179898	-0.284200
Mode	1.555800	0.664700	0.094000
SD	1.155765	1.192406	0.996152
Variance	1.335792	1.421833	0.992319
Skewness	-0.194693	-0.091865	0.245774
Kurtosis	-0.296833	0.149749	1.083320

4.2 Test of Normality

K-S test and S-W test were carried out on these three variables using SPSS to evaluate whether the data conforms to normal distribution (see Table 3). In both tests, the null hypothesis (H0) is that the data follows a normal distribution, and the alternative hypothesis (H1) is that the data does not follow a normal distribution. The p-values of the three variables are all 0.000, which are lower than 0.05. Moreover, based on the histograms (Figure 1-Figure 3), it is found that the three variables do not follow a normal distribution. Therefore, Spearman's rank-order correlation analysis will be adopted in the subsequent correlation analysis.

Table 3. Test of Normality

Test of Normality						
	K-S			S-W		
	Statistics	DF	Sig	Statistics	DF	Sig
MA	0.079	4368	0.000	0.965	4368	0.000
MTS	0.096	4731	0.000	0.955	4731	0.000
EPM	0.069	4356	0.000	0.970	4356	0.000

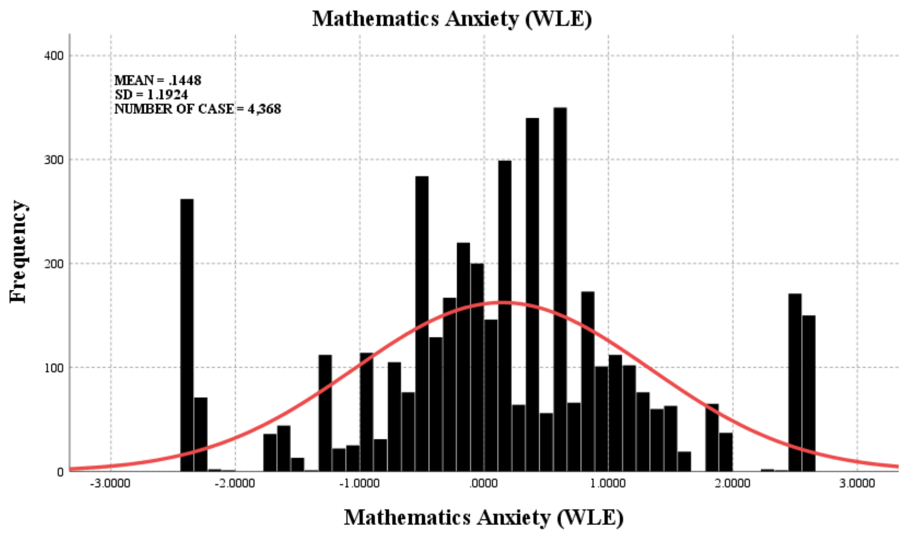

Figure 1. The Normal Distribution of MA

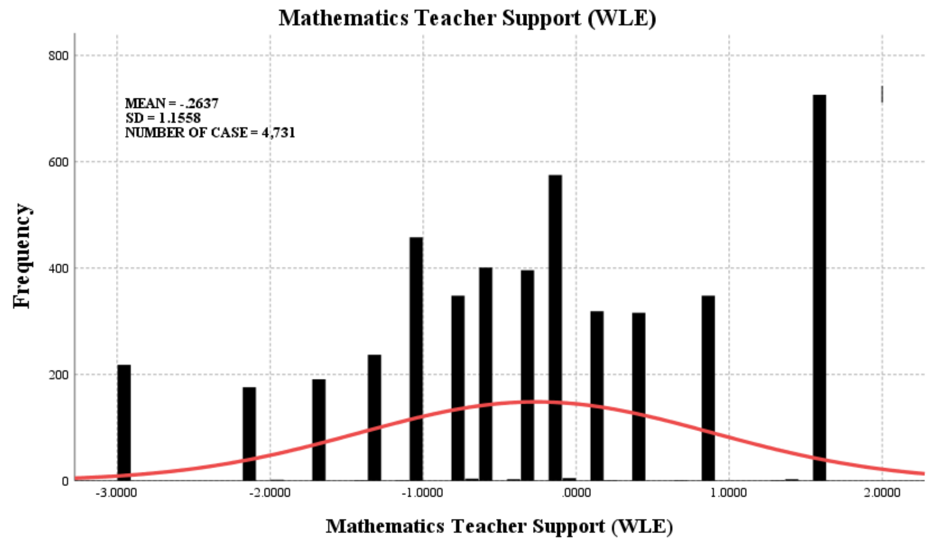

Figure 2. The Normal Distribution of MTS

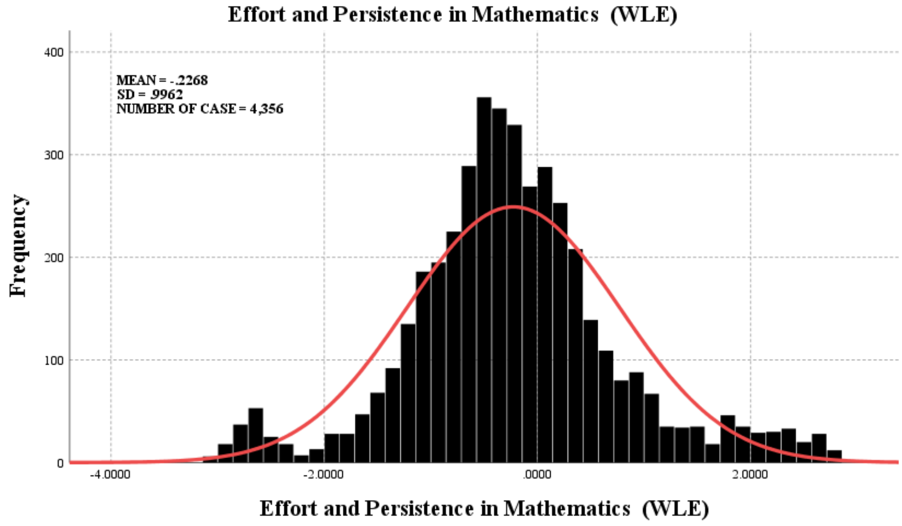

Figure 3. The Normal Distribution of EPM

4.3 Correlation Analysis

This study conducted a non-parametric correlation analysis on three variables: MTS, MA, and EPM. The Spearman Rho correlation coefficient was used to measure the correlations between the variables. The data analysis results are shown in Table 4. The correlation coefficient between MTS and MA is −0.129, and the Sig. is 0.000, showing a significant negative correlation, meaning higher MTS leads to lower MA. The correlation coefficient between MTS and EPM is 0.231 with a Sig. of 0.000, indicating a significant positive correlation, that is, more support from math teachers results in higher EPM. The correlation coefficient between MA and EPM is −0.105 and the Sig. is 0.000, showing a significant negative correlation, namely higher MA leads to lower EPM.

Table 4. The Spearman's Correlation

Correlation			
	MTS	MA	EPM
MTS	1.000		
MA	−0.129**	1.000	
EPM	0.231**	−0.105**	1.000
At level 0.01 (two-tailed), the correlation was significant.			

4.4 Findings

In summary, the results show that the three variables have different central tendencies, dispersion degrees, and distribution shapes. The data distribution of MTS and the degree of EPM is biased towards negative values, while that of MA is biased towards positive values. Moreover, the large differences between the mode and the mean and median suggest that the data may not follow a normal distribution, and the dispersion degree of MA is relatively large.

Through the K-S test and the S-W test, the P-values of all three variables are 0.000, which are less than 0.05. Combined with the histograms, it is determined that none of the three variables follow a normal distribution. The correlation analysis indicates that there is a significant negative correlation between MTS and MA, a significant positive correlation between MTS and the degree of EPM, and a significant negative correlation between MA and the degree of EPM. Specifically, the higher the MTS, the lower the students' MA; the greater the MTS, the higher the students' EPM; and the higher the students' MA, the lower their EPM.

5 Discussion

This study focuses on the correlations among MTS, MA, and EPM. The results show three variables have different central tendencies, degrees of dispersion, and distribution patterns. It is found that none of the three variables follow a normal distribution. Correlation analysis reveals that MTS is significantly negatively correlated with MA, significantly positively correlated with EPM, and MA is significantly negatively correlated with EPM.

This research, in line with prior studies, reaffirms the crucial role of teacher support in students' mathematics learning. Multiple studies have indicated its positive influence on academic emotions and performance [35]. Herein, it's further emphasized that teacher support not only alleviates students' MA but also directly promotes EPM. The negative correlation between MA and EPM in this study aligns with previous findings, such as Hembree's (1990) work showing MA's negative impact on students' learning willingness and effort. Our results support this and are validated in primary school samples [32].

Given the significant impact of teacher support on MA and EPM, diverse support strategies are advocated. Teachers can offer emotional support by attending to students' learning emotions and motivating participation, provide cognitive support via various teaching methods for knowledge and strategy mastery, and give autonomy support to enhance motivation and confidence. Timely detection and intervention for MA issues are necessary. As MA negatively affects EPM, teachers can relieve it through counseling and conversations, guiding students to handle difficulties, overcome fear, and foster a positive attitude. Moreover, teaching support should be adjusted based on individual differences to maximize its positive effect.

Nevertheless, this study has limitations. The sample from specific schools limits representativeness and generalization. The questionnaire method is affected by students' subjective factors, reducing measurement objectivity. The cross-sectional design fails to clarify causal relationships among variables. Future research could explore the internal mechanisms of how teacher support impacts MA and EPM, such as the role of mediating variables like self-cognition and motivation for intervention support.

6 Conclusion

This study aimed to investigate the correlations among the variables. Through comprehensive data analysis, several key findings emerged. There exist significant relationships. A significant negative correlation was identified between MTS and MA. MTS was positively correlated with EPM. There was also a significant negative correlation between MA and EPM.

6.1 Limitation

The sample of this study was solely drawn from some schools in specific regions, and thus its representativeness might be limited and unable to be generalized to a broader student population. Future research should expand the sample scope to cover students from different regions and various types of schools so as to enhance the universality of the research results.

Moreover, this study mainly adopted the questionnaire survey method to collect data, which might be subject to the bias of students' subjective reports. Students' perceptions of MTS, MA, and EPM could be influenced by multiple factors, such as their emotional states at that time and their understanding of the questions, thereby affecting the accuracy of the measurement results. Subsequent research could combine other measurement methods, such as teacher evaluations and classroom observations, to obtain more objective and comprehensive data.

Finally, this study was a cross-sectional study, which was unable to determine the causal relationships among the variables. Although the correlations among MTS, MA, and EPM were found, it could not be clearly determined whether changes in MTS directly led to alterations in

MA and EPM, nor could the long-term effects of such influence be identified. Future research could adopt a longitudinal study design to track the changes of students over a period of time, so as to better reveal the causal relationships among the variables.

6.2 Future

Future studies could explore the internal mechanisms through which MTS affects MA and EPM in more depth. For example, investigating the detailed processes mediated by variables such as self-perception and learning motivation to provide theoretical support for intervention measures. Comparing the differences in the impact of teacher support in different disciplines and teaching styles on MA and EPM could assist teachers in optimizing their support strategies. Examining the interactions between factors such as family environment and peer relationships with MTS, MA, and EPM could build a more comprehensive system of influencing factors and provide a basis for comprehensive interventions, thereby further advancing research in this field and improving mathematics education outcomes.

Future research could further integrate artificial intelligence (AI) to expand the understanding of how technology mediates the relationships among MTS, MA, and EPM. Emerging studies highlight AI's potential to optimize teacher support delivery, alleviate academic anxiety, and enhance learning persistence—all critical to addressing gaps in current mathematics education research.

Gao et al (2025) explored AI chatbot-integrated tasks, finding they can boost self-efficacy and critical thinking; this suggests AI chatbots could serve as supplementary tools to extend MTS (e.g., providing personalized math problem-solving guidance outside class), thereby reducing MA and reinforcing EPM [36]. Li et al (2023) studied middle school students' ChatGPT usage, noting that AI tools can support independent math learning but require teacher oversight to avoid over-reliance—implying AI could complement MTS by fostering autonomous learning, a key driver of EPM [37].

AI also enhances the quality and scalability of teacher support systems. Duan et al (2025) examined AI-assisted quality assurance at Hong Kong's Lingnan University, demonstrating AI's ability to monitor instructional effectiveness; applying this to mathematics education, AI could help identify gaps in MTS (e.g., uneven emotional support for students with high MA) and enable targeted teacher training [38]. Li and Xie (2025) proposed a synergy of generative AI (Gen-AI) and human expertise for educational quality assurance, which could support cross-regional comparisons of MTS strategies (e.g., how AI-enhanced support differs in reducing MA across cultural contexts) [39].

For student well-being—a factor intersecting with MA—Zheng et al (2025) researched AI-driven mental health mechanisms for college students, showing AI can mitigate academic stress; adapting this to mathematics education, AI mental health tools could complement MTS by addressing MA-related emotional distress, indirectly boosting EPM [40]. Sun et al (2024) investigated AI-enhanced we-media platforms in vocational education, revealing their role in facilitating peer and teacher-student communication; such platforms could be used to share math learning resources or peer support networks, reinforcing MTS's positive impact on EPM [41].

Finally, AI supports teacher professional development, a foundational factor for effective MTS. Huang et al (2025) addressed post-pandemic teacher performance management, noting AI can identify gaps in equitable teaching practices; AI-driven training could help teachers refine MTS strategies (e.g., tailoring cognitive support for students with high MA), ensuring support is both effective and scalable. Integrating these AI-focused insights would not only enrich the theoretical framework of MTS-MA-EPM relationships but also provide practical tools to enhance mathematics education outcomes [42].

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