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Preservice Mathematics Teachers' Emotional Expression and Students' Academic Engagement: The Mediating Role of Students' Academic Self-efficacy

Xueting Zhang*, Wong Siew Ping

Faculty of Education and Liberal Studies, City University Malaysia, Kuala Lumpur 46100, Malaysia.

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Corresponding author: Xueting Zhang, Faculty of Education and Liberal Studies, City University Malaysia, Kuala Lumpur 46100, Malaysia.

Abstract

The underlying mechanism through which teachers' emotional expression influences students' academic engagement in pre-service mathematics teacher education programs warrants deeper investigation, with particular focus on the mediating role of students' self-efficacy. This study utilized a random sampling strategy to recruit participants, comprising first- through fourth-year undergraduates who met the study's inclusion criteria. A hybrid online-offline data collection approach was employed to administer 500 questionnaires, resulting in 413 valid responses (Freshman: n= 109; Sophomore: n= 100; Junior: n= 137; Senior: n= 67). Structural equation modeling (SEM) was conducted using AMOS 26.0 for data analysis. The measurement scale exhibited robust internal consistency and construct validity, and the SEM demonstrated acceptable model fit. Regarding direct effects, teachers' emotional expression exerted a significant positive effect on both students' academic engagement and self-efficacy, confirming Hypotheses 1 and 2. Additionally, students' self-efficacy was positively associated with their academic engagement, supporting Hypothesis 3. Furthermore, students' self-efficacy partially mediated the relationship between teachers' emotional expression and students' academic engagement (standardized indirect effect =.58, 95% CI [0.49-0.69], [0.48-0.68]). Students' self-efficacy was identified as a partial mediator in the association between pre-service mathematics teachers' emotional expression and students' academic engagement.

Keywords

Emotional Expression; Academic Engagement; Preservice Math Teacher Education; Self-efficacy

1. Introduction

Mathematics education plays a fundamental and pivotal role in the modern information society, and its importance has been increasingly emphasized globally (Chen, 2020). Mathematics education is essential for a country's scientific and technological development and plays a crucial role in China's basic education system, including primary, middle, and high schools. It not only imparts knowledge and skills but also helps cultivate students' logical thinking, problem-solving abilities, and scientific attitudes (Ministry of Education of the People's Republic of China, 2020).

Therefore, mathematics education is the core component within China's science-oriented education system. In particular, mathematics teacher education is the crucial major dedicated to cultivating future teachers for fundamental mathematics education, and its significance is irreplaceable.

However, in the context of mathematics teacher education in China, empirical data have revealed notable instances of insufficient learning participation among students. For example, Li (2022) conducted a comprehensive survey across multiple normal universities and discovered that in certain core mathematics courses, approximately 30% to 40% of the students exhibited low levels of active participation. Specifically, they were reluctant to initiate questions and were generally inactive during group discussions. Moreover, mathematics teacher education students in China display a range of behaviors indicative of insufficient learning participation. In the classroom, a prominent issue is the lack of proactive engagement. Wang (2021) observed that in essential courses such as mathematical analysis and advanced algebra, the proportion of students who actively participated by posing questions was less than 10%. These students typically adopted a passive approach to learning, relying heavily on teacher-led instruction.

At the university stage, preservice mathematics teacher education refers to the process of training individuals to become mathematics teachers before they enter the profession. This process involves courses in mathematical content, pedagogy, and educational psychology, as well as practical teaching experiences (Liu & Wang, 2019). The goal of preservice mathematics teacher education is to equip future teachers with the knowledge, skills, and professional dispositions needed to effectively teach mathematics in schools. Moreover, preservice mathematics teacher education is instrumental in addressing the multifaceted challenges faced by China's basic education system. By focusing on the comprehensive development of future teachers, including their emotional intelligence, teaching strategies, and self-efficacy, this education can create more attractive and efficient learning environments in university mathematics classrooms (Liu & Wang, 2019). It is conducive to cultivating preservice mathematics education teachers, that is, mathematics teachers for future basic academic education, which is crucial for enhancing primary and secondary school students' motivation, confidence, and overall academic performance in mathematics.

In the higher educational curriculum system, mathematics education needs to focus not only on the transmission of knowledge but also on the cultivation of students' comprehensive qualities and abilities (Liu & Wang, 2019). In this process, teachers' emotional expression, as an important part of teaching behavior, has a profound impact on students' learning motivation, interest, and academic engagement (Li, 2021). However, in the current university mathematics education, teachers' emotional expression often receives insufficient attention, which leads to some problems, such as students' low learning interest and poor academic engagement.

Academic engagement refers to the degree of involvement and effort that students put into their academic tasks (Zhang & Chen, 2020). High academic engagement is closely related to students' academic performance, learning satisfaction, and future career success (Wang & Liu, 2018). However, in university mathematics education, students' academic engagement often needs to be further improved. This may be related to factors such as teaching methods, classroom atmosphere, students' own psychological characteristics, and even to the teacher's emotional expression (Shi & Yang, 2019).

Academic self-efficacy refers to individuals' belief in their ability to successfully complete academic tasks (Bandura, 1986). Academic self-efficacy has a significant impact on students' learning motivation, learning strategies, and academic performance (Multon et al., 2018). In the published studies, academic self-efficacy has been demonstrated in various educational contexts. For example, in language learning, a study by Chen and Huang (2019) found that students' perceived teacher support was positively related to their language learning achievement. However, this relationship was mediated by academic self-efficacy. That is, when students perceived more support from their teachers, they tended to have higher academic self-efficacy, which in turn led to better language learning outcomes. In the field of social studies education, a study by Sun (2021) showed that classroom participation was related to students' overall academic achievement. And academic self-efficacy mediated this association. Students who actively participated in classroom discussions and activities were more likely to develop a stronger sense of academic self-efficacy, which then contributed to their better overall academic performance. These examples from different educational fields clearly illustrate the important mediating role of academic self-efficacy. In university mathematics education, cultivating students' academic self-efficacy might also be of great significance for improving their academic engagement and learning outcomes.

The purpose of this study is to explore the relationship between teachers' emotional expression and students' academic engagement in preservice mathematics teacher education and the mediating role of students' academic

self-efficacy in it. This study aims to provide new perspectives and a theoretical basis for improving university mathematics education and promoting mathematics students' comprehensive development in preservice mathematics education.

2. Literature Review

2.1 The Impact of Teachers' Emotional Expression on Students' Academic Self-Efficacy and Learning Engagement

Teaching constitutes an emotionally intensive profession, wherein teacher emotions permeate the entire instructional process (Hargreaves, 2000). Research indicates that the quality of teachers' emotional expression directly influences classroom interactions (Poulou & Denham, 2023), student academic engagement (Wang, 2022), and teachers' own well-being (Burić & Moè, 2020). Teachers play a very important role in students' studies and lives. Since the Pygmalion effect was proposed, academic research on teachers has also been increasing continuously. The research shows that students' perception of teachers' expectations and positive attitudes will enhance their learning engagement (Tomás et al., 2019). Within classroom contexts, teachers may experience positive emotions (e.g., joy, fulfillment) upon achieving instructional goals, yet they may also encounter negative emotions (e.g., anger, frustration) triggered by student misbehavior (Lee & van Vlack, 2017). Notably, teachers' emotions primarily stem from classroom management challenges rather than the instructional content itself (Stark & Bettini, 2021), and the expression of negative emotions can impair the quality of teacher-student interactions (Stark & Bettini, 2021).

Based on Self-Determination Theory (SDT), teacher emotional expression refers to students' subjective experience of an emotional connection with their teachers (Pianta et al., 2008). This comprises two key dimensions: teachers' sensitive responses to students' needs and the display of enthusiasm and warmth during instruction. Studies have shown that such emotional connections can enhance students' psychological safety (van Kleef et al., 2024), thereby fostering the development of learning motivation. Longitudinal research has confirmed that teacher encouragement during early education stages is significantly positively correlated with students' academic achievement and social development (Liu & Wang, 2022). A quasi-experimental study by Hamre et al. (2013) found that high-quality emotion significantly reduces the dropout risk among first-grade students with behavioral issues. Through randomized grouping, the study demonstrated that students lacking adequate emotional support exhibited declining academic performance, reduced classroom participation, and increased teacher-student conflicts. This finding aligns with Maslow's hierarchy of needs, indicating that the fulfillment of emotional needs is a prerequisite for cognitive development (Rosenfeld, 2000).

Educators' emotional expression is a critical factor in high-quality instructional interactions. In the context of mathematics education, positive emotion holds unique significance. Huang and Liu (2025) found that teacher emotional expression indirectly promotes academic engagement by enhancing school belongingness, revealing a positive correlation between teacher emotional support and learning engagement, with school belongingness serving as a mediator. When students internalize their teachers' trust and expectations, they autonomously regulate their learning engagement to meet these standards.

Academic self-efficacy denotes students' beliefs in their ability to mobilize the knowledge and skills they have acquired to successfully complete academic tasks. In mathematics education contexts, academic self-efficacy specifically corresponds to the dimension of competence needs (Marzano, 2008). When students are confident in their ability to succeed in mathematics learning, their persistence and engagement in tackling challenging mathematical problems significantly improve (Kang, 2024). This study further posits that teachers' emotional expression satisfies students' psychological needs through differentiated pathways: emotional support primarily fulfills autonomy needs (e.g., enhancing learning autonomy through encouraging feedback), while academic self-efficacy primarily fulfills competence needs (e.g., reinforcing mathematical ability beliefs through successful experiences). The synergistic effect of these two factors creates optimal psychological conditions for academic engagement (Liu et al., 2017).

However, existing research has an important limitation: most studies examine teacher emotional support as part of the social support system (Poulou et al., 2022) or as a composite dimension of teacher support, lacking a systematic investigation of its independent effects. To address this gap, this study positions teachers' emotional expression as the core independent variable, focusing on its unique role in mathematics teacher education. Based on the above

theoretical analysis and empirical evidence, the following research hypotheses are proposed:

H1: Mathematics teachers' emotional expression positively predicts students' academic engagement.
H2: Mathematics teachers' emotional expression positively promotes students' academic self-efficacy.

2.2 The Impact of Students' Academic Self-Efficacy on Learning Engagement

Extensive empirical research has consistently demonstrated that academic self-efficacy exerts stable and significant positive predictive effects on learning engagement behaviors, a relationship that has been validated across diverse educational contexts (Meng & Zhang, 2023). According to Bandura's (1977) theoretical framework, students with high academic self-efficacy typically exhibit three distinguishing characteristics: stronger achievement motivation, greater task persistence, and more flexible application of learning strategies (Wang & Tambi, 2024). These students demonstrate a marked propensity for selecting more challenging learning goals, which in turn reinforces their competitive orientation and engagement behaviors.

Cross-contextual studies have revealed remarkable stability in the relationship between academic self-efficacy and learning engagement. Investigation of military academy students demonstrated that even in high-stress environments, academic self-efficacy maintains its positive predictive power over engagement levels, though this relationship is moderated by academic pressure (Yao, 2015). These findings not only confirm the universality of the mechanism but also delineate the boundary effects of environmental factors. This aligns perfectly with Bandura's (1977) theoretical proposition that students with strong academic self-efficacy, driven by heightened achievement motivation, preferentially select challenging learning objectives. The inherent difficulty of these goals further activates their competitive drive, thereby enhancing learning engagement.

Recent years have witnessed a deepening understanding of the underlying mechanisms. Lin Jie et al. (2020) identified three distinct pathways through which high academic self-efficacy promotes engagement. At the cognitive level, it facilitates deeper knowledge processing; at the affective level, it strengthens psychological resilience; and at the behavioral level, it stimulates opportunity-seeking behaviors. This multidimensional pathway model provides a more comprehensive framework for understanding the mechanisms of academic self-efficacy's influence.

Existing research presents two notable gaps. First, there has been limited exploration of the integrated mechanism linking teacher emotional support, academic self-efficacy, and learning engagement. Second, quantitative studies that empirically test mediation pathways within this mechanism remain insufficient. Guided by the theoretical perspective that environmental influences shape self-perceptions, which in turn drive behavioral manifestations (see Bandura, 1997; Pianta et al., 2012), teacher emotional support may function as a critical environmental factor that enhances students' academic self-efficacy, thereby promoting higher levels of learning engagement. This study innovatively proposes a complete chain of influence wherein teacher emotional support potentially affects learning engagement through academic self-efficacy, offering significant theoretical value and practical implications for developing more systematic educational interventions. Based on the above literature review, the study proposes:

H3: Students' academic self-efficacy significantly and positively predicts their academic engagement.
H4: Students' academic self-efficacy mediates the relationship between teachers' emotional expression and students' academic engagement.

3. Research Method

3.1 Participants and Research Location

This study selected Boda College of Jilin Normal University as the research location. Located in Northeastern China, Boda College is a higher education institution. Students eligible for the study comprised all mathematics teacher education majors at the college. Through random sampling, a total of 413 participants were selected from the eligible students, with males accounting for 31% of the sample (mean age = 20.84 ± 1.54). In terms of academic standing, participants were categorized into four groups: Freshman (n = 109), Sophomore (n = 100), Junior (n = 137), and Senior (n = 67).

3.2 Measures

The measurement of dimension for teachers' emotional expression in preservice math teacher education was adopted by Wei and Xu (2022), comprising four items (Table 1). This measure was scored on a 5-point Likert-type

scale ranging from 1 = strongly disagree to 5 = strongly agree. The higher the score, the higher from teachers in math education. In the present study, the Cronbach's alpha score for reliability was 0.926.

The measure for students' academic engagement, adopted from the questionnaire from Schaufeli et al. (2002), included 13 items across three dimensions: absorption (5 items), dedication (3 items), and vigor (5 items). This measure was scored on a 5-point Likert-type scale ranging from 1 = strongly disagree to 5 = strongly agree. In the present study, we observed Cronbach's α greater than 0.900 for the three factors measured.

The measure for self-efficacy May (2009) consists of 7 items. This measure was scored on a 5-point Likert-type scale ranging from 1 = strongly disagree to 5 = strongly agree. The higher the score, the higher the self-efficacy. In the present study, we observed a reliability coefficient of the self-efficacy factor (Cronbach's α) of 0.976.

Table 1. Measurement of latent variables

Dimension	Manifest variables	Measure description
Emotional Expression[1]	My Mathematics teacher cares about me/us.	–
	My Mathematics teacher stops to ask me/us if there are any questions.	–
	My Mathematics teacher helps me/us when I/we need help.	–
	My Mathematics teacher can sympathize with me/us and give me/us the needed support.	–
Academic Engagement[2]	Absorption	When I am studying, I forget everything else around me.
		Time flies when I am studying.
		I get carried away when I am studying.
		I am immersed in my studies.
		I feel happy when I am studying intensely.
	Dedication	My study inspires me.
		I am enthusiastic about my studies.
		I am proud of my studies.
	Vigor	When I'm doing my work as a student, I feel bursting with energy.
		As far as my studies are concerned, I always persevere, even when things do not go well.
		I can continue studying for very long periods at a time.
		I am very resilient, mentally, as far as my studies are concerned.
		I feel strong and vigorous when I'm studying or going to class.
Self-Efficacy[3]	I feel confident enough to ask questions in my mathematics class.	–
	I believe I can understand the content in a mathematics course.	–
	I believe I can get an "A" when I am in a mathematics course.	–
	I feel that I will be able to do well in future mathematics courses.	–
	I believe I can do the mathematics in a mathematics course.	–
	I believe I can think like a mathematician.	–
	I feel confident when using mathematics outside of school.	–

[1]scored as 1 = strongly disagree, 5 = strongly agree; Dimension based on Wei and Xu (2022).
[2]scored as 1 = strongly disagree, 5 = strongly agree; Dimension based on Schaufeli et al. (2002).
[3]scored as 1 = strongly disagree, 5 = strongly agree; Dimension based on May (2009).

3.3 Data Collection

A mixed-method survey design was implemented, combining online and offline data collection. Online questionnaires were distributed via QR codes, while on-site administration involved two math teachers and four trained student assistants who clarified questionnaire objectives to enhance response accuracy and completeness. A total of 500 questionnaires were distributed, yielding 413 valid responses, resulting in a valid response rate of 82.6%. All subjects were verbally informed of the purpose and requirements of the research, provided written consent.

3.4 Data Analysis

Analytical procedures were executed using AMOS 26.0 and SPSS 26.0, beginning with verifying the reliability and validity of the measurement model via confirmatory factor analysis (CFA). We then constructed a structural equation model. We also used CFA to evaluate both structural and discriminant validity, following the protocol established by Brown and Moore (2012). The culmination of this model testing was pivotal in ascertaining whether the revised model provided an accurate reflection of the collected data. This verification set the stage for more in-depth analysis and interpretation of the findings.

4. Results

4.1 Reliability and Validity of the Scale

Table 2 presents key psychometric properties of the measurement models, with all standardized factor loadings surpassing the critical cutoff of 0.05. For every latent construct, composite reliability coefficients remained uniformly above 0.90, underscoring robust structural reliability. The average variance extracted (AVE) metrics for each construct likewise exceeded the prescribed threshold of 0.50, further confirming strong convergent validity. The model fit indices associated with the measurement models (Table 3) exhibited acceptable congruence with a priori theoretical expectations. As illustrated in Table 4, the squared correlations between latent constructs remained uniformly lower than their corresponding AVE values, yielding robust empirical support for discriminant validity across all pairs of constructs.

Table 2. Reliability and validity of the scale

Dimension	Second order	Item	Unstd.	S.E.	Z	P	Std.	SMC	CR	AVE
Emotional Expression		EE1	1				0.899	0.808	0.962	0.862
		EE2	1	0.029	34.055	***	0.956	0.914		
		EE3	0.975	0.031	31.631	***	0.931	0.867		
		EE4	0.984	0.032	31.202	***	0.927	0.859		
Self-Efficacy		SE1	1				0.857	0.734	0.976	0.851
		SE2	0.984	0.035	28.193	***	0.935	0.874		
		SE3	1.044	0.036	28.638	***	0.941	0.885		
		SE4	1.005	0.036	27.935	***	0.931	0.867		
		SE5	1.049	0.034	30.471	***	0.966	0.933		
		SE6	1.058	0.041	25.870	***	0.898	0.806		
		SE7	0.988	0.036	27.750	***	0.928	0.861		
Academic Engagement	Absorption	Ab1	1				0.875	0.766	0.968	0.859
		Ab2	0.932	0.032	29.525	***	0.933	0.870		
		Ab3	0.989	0.032	31.067	***	0.952	0.906		
		Ab4	1.021	0.034	29.667	***	0.935	0.874		
		Ab5	1.033	0.035	29.910	***	0.938	0.880		
	Dedication	De1	1				0.952	0.906	0.964	0.899
		De2	1.022	0.023	44.936	***	0.966	0.933		
		De3	0.914	0.024	37.735	***	0.926	0.857		

Table 2 Continued

	Vigor	Vi1	1				0.870	0.757	0.969	0.861
		Vi2	0.899	0.033	27.026	***	0.903	0.815		
		Vi3	0.994	0.032	31.223	***	0.959	0.920		
		Vi4	0.970	0.031	30.999	***	0.957	0.916		
		Vi5	1	0.033	30.234	***	0.947	0.897		

Table 3. Model fit

Fit Indices	Measurement Model					Reference Value
	EE	SE	AE		Vi	
			Ab	De (3 items)		
	Model Value					
χ^2/df	2.874	3.724	3.726	–	3.722	< 5
RMSEA	0.067	0.081	0.081	–	0.081	< 0.08
SRMR	0.005	0.009	0.007	–	0.008	< 0.08
CFI	0.998	0.991	0.995	–	0.995	> 0.95
TLI	0.994	0.986	0.990	–	0.990	> 0.95
GFI	0.993	0.967	0.984	–	0.983	> 0.90
AGFI	0.966	0.933	0.951	–	0.948	> 0.90

Table 4. Composite reliability and discriminant validity

	CR	AVE	SE	AE	EE
SE	0.976	0.851	0.922		
AE	0.957	0.881	0.902	0.939	
EE	0.962	0.862	0.654	0.741	0.928

Notes: EE-Emotion expression; AE-Academic achievement; SE-Self-efficacy

4.2 Model Hypothesis Test

4.2.1 Direct Effects Test

Employing the Bollen-Stine bootstrap methodology, the ultimate model fit statistics were computed as follows: χ^2/df = 3.016, SRMR = 0.052, RMSEA = 0.070, GFI = 0.955, AGFI = 0.950, CFI = 0.970, and TLI = 0.966, collectively demonstrating favorable model fit. Table 5 further illustrates the analysis outcomes, revealing notable positive associations: Emotional expression displayed robust positive linkages with academic engagement (r = .22, p < .01) and self-efficacy (r = .74, p < .01). The standardized direct effects of emotional expression on academic engagement (β = .20, p < .01) and self-efficacy (β = .65, p < .01) each attained statistical significance, thereby providing empirical validation for Hypotheses H1 and H2. Concerning Hypothesis H3, the analysis demonstrated that self-efficacy exhibited a robust positive association with academic engagement (r = .78, p < .01), with its standardized direct effect on academic engagement also reaching statistical significance (β = .82, p < .01), thus affirming the validity of Hypothesis H3.

Table 5. Test results of the path relationship hypothesis

Hypothesis	Path relationship	Unstd.	S.E.	*Z*	*p*	Std.	Results
H1	EE→AE	0.219	0.028	7.926	***	0.203	Support
H2	EE→SE	0.739	0.051	14.450	***	0.654	Support
H3	SE→AE	0.782	0.039	20.079	***	0.818	Support

Notes: EE-Emotion expression; AE-Academic achievement; SE-Self-efficacy

4.2.2 Mediation Effect Test

To assess the indirect influences of the dependent variable via mediating factors, we employed both percentile bootstrap and bias-corrected percentile bootstrap techniques, utilizing 5,000 bootstrap samples under a 95% confidence interval framework. As illustrated in Table 6, the bootstrap analysis generated the following results: A statistically significant positive mediating effect of emotion expression on academic engagement through self-efficacy was observed, with a standardized indirect effect of 0.58 and 95% confidence intervals spanning [0.49-0.69] and [0.48-0.68].

Table 6. Results of mediation effects

Path relationship	Point Estimate	Coefficient		Bootstrap Test					
				Bias-corrected Percentile			Percentile		
		SE	*Z*	Lower	Upper	*p*	Lower	Upper	*p*
Direct effect	0.219	0.041	5.341	0.137	0.298	0.000	0.137	0.297	0.000
Indirect effect	0.578	0.051	11.333	0.485	0.686	0.000	0.480	0.679	0.000
Total effect	0.797	0.046	17.326	0.708	0.889	0.000	0.705	0.885	0.000

5. Discussion and Recommendations

This study aims to investigate the influence of teachers' emotional expression on student academic engagement within preservice mathematics teacher education by developing a theoretical model, with a primary focus on examining the mediating effect of student academic self-efficacy. Key findings of the study indicate that: (1) Teachers' emotional expression in preservice mathematics teacher education significantly and positively influences both student academic engagement and student academic self-efficacy; (2) Student academic self-efficacy also exerts a significant positive impact on student academic engagement. Through mediating effect analysis, it was further revealed that student academic self-efficacy plays a partial mediating role in the relationship between teachers' emotional expression and student academic engagement.

The educational implications of teachers' emotional expression lie in encouraging students to open up, enhancing teacher-student relationship building, meeting students' psychological needs, and promoting students' diversified development (Xu, 2022). Studies have shown that teachers' positive emotional expression can significantly influence students' social and emotional competence and their adjustment to school (Poulou & Denham, 2023). The findings of this study indicate that in preservice mathematics teacher education, teachers' emotional expression significantly and positively influences students' academic engagement and academic self-efficacy. Prosen et al. (2013) argued that positive emotional expression has an encouraging effect on students' learning processes, whereas negative emotional expression hinders students' memory, motivation, and creativity. In a teaching experiment, Wang (2022) found that compared to the traditional teaching group, students in the teaching group with enhanced teacher emotional expression were better able to retain learning over the long term. In this process, the enhancement of students' arousal level and reduction of cognitive load through teachers' emotional expression are the key mechanisms driving student engagement and sustained learning (Wang, 2022). In mathematics teaching practice, teachers' positive emotional expression enables students to maintain a happy and relaxed mood during learning, and students perceive that with teachers' support, they are competent to complete learning tasks.

The findings of this study indicate that student academic self-efficacy exerts a partial mediating effect in the relationship between teachers' emotional expression and student academic engagement. A large body of research has supported the positive role of academic self-efficacy. Yokoyama (2018) found in a review study that high academic self-efficacy among students significantly influenced their academic performance in most online teaching contexts within higher education institutions. Dogan (2015) observed in teaching experiments with junior and senior high school students that academic self-efficacy served as one of the predictors of academic performance, suggesting that stronger awareness of self-competence promotes greater academic success. Bassi et al. (2007) conducted a longitudinal study on 130 adolescents in Italy and found that students with high self-efficacy held elevated academic aspirations and pursuits, and were more inclined to spend additional time on homework.

In the context of Chinese mathematics education, the subject-matter teaching practices of preservice mathematics

teachers undertake the critical mission of cultivating competent basic mathematics educators. By constructing a theoretical framework, this study systematically examines two key relationships within preservice mathematics teacher education: the influence of teachers' emotional expression on student academic engagement and the mediating role of student academic self-efficacy. The latter, as a pivotal psychological construct, serves as a critical mechanism for optimizing teachers' emotional expression to foster students' proactive participation in mathematics learning. Nevertheless, the present investigation reveals insufficient exploration of specific psychological variables that underpin these theoretical linkages—such as motivational dynamics and cognitive processes—which warrant closer examination in future research. Further observations reveal that psychological disparities persist between pre-service and in-service teachers. For example, limited practical teaching experience often leaves pre-service teachers with lower self-confidence—a gap that translates to less stable emotional regulation during their classroom practice. Consequently, higher education institutions tasked with preparing future basic mathematics educators should prioritize enhancing pre-service teachers' emotional management training. Through targeted interventions—including simulated classroom-based emotional regulation exercises and case studies of emotion expression—these institutions can optimize pre-service teachers' ability to navigate classroom emotions effectively. Directions for subsequent inquiry are thus directed toward deepening understanding of these understudied psychological factors.

6. Conclusion

This study is designed to explore the impact of teachers' emotional expression on student academic engagement within the context of preservice mathematics teacher education, with a specific emphasis on examining the mediating role of student academic self-efficacy. The empirical results demonstrate that, in preservice mathematics teacher education settings, teachers' emotional expression exerts a significant positive influence on both student academic engagement and the development of students' academic self-efficacy. Concurrently, student academic self-efficacy is also shown to significantly and positively predict student academic engagement. Through mediation analysis, it is further revealed that student academic self-efficacy serves as a partial mediator in the relationship between teachers' emotional expression and student academic engagement. Future research endeavors should prioritize empirical investigations to elucidate the roles of diverse psychological variables (e.g., motivational orientations, cognitive processes) in this dynamic relationship. The findings of this study offer practical guidance for educators in preservice mathematics teacher programs, informing strategies for intentional emotional expression to foster student academic engagement during instructional interactions. Additionally, they provide theoretical foundations for students to cultivate self-efficacy beliefs, which in turn can facilitate the achievement of more optimal academic outcomes.

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