Elementary Mathematics Teachers' Emotional Expression and Student Academic Engagement: A Moderated Mediation Model of Students' Self-Efficacy and Digital Literacy

Zhang Xueting , Suhaidah Tahir and Wong Siew Ping

Abstract – While teacher emotional expression is known to shape student outcomes, its mechanism within digitalized mathematics classrooms remains underexplored. Surveying 400 upper-elementary students in Jilin Province, this study tested a moderated mediation model. Results indicated that students' self-efficacy partially mediated the link between teachers' emotional expression and academic engagement (indirect effect = 0.134, 95% CI [0.088, 0.182]). Notably, teachers' digital literacy acted as a suppressor moderator: the positive effect of emotional expression on self-efficacy was strongest for teachers with lower digital literacy (simple slope = 0.414) and attenuated for those with higher digital literacy (simple slope = 0.040). These findings suggest that pedagogical reliance on emotional cues may diminish as technological proficiency increases.

Keywords– Teacher emotional expression, Student academic engagement, Self-efficacy, Digital literacy, Elementary mathematics education

I. INTRODUCTION

Mathematics education plays a foundational and pivotal role in modern information societies, a significance increasingly recognized worldwide (Chen, 2020). At the basic education level, mathematics serves not merely as a conduit for knowledge and skills, but as a critical arena for cultivating students' logical reasoning, problem-solving abilities, and scientific attitudes. Consequently, elementary mathematics education forms the cornerstone of China's science-oriented education system. However, empirical data reveal a stark reality of insufficient student engagement within primary school classrooms. For instance, Li (2022) notes that in certain elementary mathematics classrooms, approximately 30% to 40% of students exhibit low levels of active participation. A prominent issue is the lack of active interaction; Wang (2021) observed that even during the instruction of core mathematical concepts, the proportion of primary school students who actively ask questions often falls below 10%. These students predominantly adopt passive, receptive learning approaches, relying heavily on teacher-led instruction. The elementary stage represents a critical period for shaping students' subject-specific affect, a focal point for both pre-service and in-service teacher education (Liu & Wang, 2019).

Furthermore, elementary mathematics education must prioritize not only knowledge transmission but also the cultivation of students' comprehensive qualities and capabilities (Liu & Wang, 2019). Within this process, teachers' emotional expression stands as a core element of instructional behaviour , exerting a profound impact on students' mathematical learning motivation, interest, and academic engagement (Li, 2021). Regrettably, in current elementary mathematics teaching practice, teachers' emotional expression often fails to receive adequate attention; this deficit directly contributes to issues such as diminished student interest and poor academic engagement.

Among the myriad environmental factors influencing student development, the emotional support provided by elementary mathematics teachers is widely regarded as a pivotal force shaping the learning experience (Boo & Lee, 2024). Through infectious encouragement, timely feedback, and patient guidance, teachers not only bolster students' academic motivation but also effectively mitigate the inherent anxiety associated with mathematics learning. Such positive teacher-student interactions cultivate a secure emotional atmosphere, significantly fostering deep student engagement in the mathematics classroom (An et al., 2023; Ma & Li, 2026). With the evolution of primary mathematics pedagogy—shifting from traditional chalkboard instruction toward digitalized and blended classrooms—heightened demands are being placed on the digital literacy of both teachers and students alike. Academic self-efficacy—defined as an individual's belief in their capacity to successfully complete specific mathematical tasks (Schunk, 1996)—plays a mediating role in this dynamic. Research indicates that self-efficacy exerts a significant impact on primary school students' motivation, strategy deployment, and ultimate academic achievement in mathematics (AL-Qadri et al., 2024). Meanwhile, digital literacy is defined as the ability to utilize digital technologies and media effectively, safely, and critically (Siddiq et al., 2017). Within the realm of mathematics education, teachers possessing higher digital literacy are better equipped to design interactive curricula, while students with solid digital skills are significantly more likely to actively participate in online problem-solving discussions, engage in collaborative inquiry with peers, and efficiently leverage digital resources to tackle complex mathematical problems—capabilities crucial for sustaining continuous engagement in technology-enhanced mathematics classrooms (Chiu et al., 2021; Prior et al., 2016).

Whereas a substantial body of literature has documented the positive impact of teacher emotional support on student academic development, granular pathways illustrating how environmental factors translate into learning engagement remain underexplored within the specific context of elementary mathematics classrooms. Specifically, the dynamic interplay among teachers' emotional expression, digital literacy, and student self-efficacy has yet to be fully disentangled; research elucidating the boundary-spanning

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role of digital literacy—whether as a moderator or mediator—is particularly scarce. Grounded in Social Cognitive Theory and existing empirical evidence, this study aims to construct a moderated mediation model linking elementary mathematics teachers' emotional expression to student academic engagement. It seeks to empirically investigate the internal mechanisms through which student self-efficacy and digital literacy operate within this relational dynamic.

II. LITERATURE REVIEW

The Impact of Teacher Emotional Expression on Student Academic Engagement

Within the context of elementary mathematics education, teachers' emotional expression stands as a pivotal determinant of student academic engagement. Existing literature often operationalizes this concept through the lens of "perceived teacher support," defined as students' subjective evaluation of the supportive behaviour s and attitudes exhibited by teachers within the academic environment (Shu et al., 2024). This construct is broadly conceptualized as multidimensional, encompassing emotional, professional, social, and instrumental support (Fang, 2023). In the mathematics classroom, emotional support—manifested through care and encouragement—helps mitigate the anxiety often associated with the subject. Professional support involves providing academic guidance and quality resources to enhance mathematical competency, while social support fosters collaborative interaction and a sense of belonging. Instrumental support includes practical assistance and timely dissemination of curricular information to aid task completion (Fang, 2023).

Self-Determination Theory provides a robust theoretical framework for understanding the linkage between teacher support and student engagement (Ryan & Deci, 2000). It posits that teacher support fulfills students' basic psychological needs for autonomy, competence, and relatedness, which in turn drive sustained participation in learning activities. Extensive empirical evidence substantiates this mechanism; for instance, Boo and Lee (2024) found that students' perceived emotional support predicts higher intrinsic motivation and self-regulated engagement in mathematics. Furthermore, distinct types of support exert differentiated effects on engagement dimensions: instrumental support assists students in navigating digital platforms and task completion (Kuo et al., 2014); social support facilitates collaborative participation in technology-enhanced learning environments (Bond & Bedenlier, 2019); and professional support enhances cognitive and metacognitive engagement by aligning structured resources and feedback with learners' goals (Siddiq et al., 2017).

Collectively, these dimensions of teacher support create motivational, behaviour al, and contextually appropriate learning conditions that encourage students to persist in using digital tools and maintain positive academic engagement in mathematics. Grounded in the aforementioned theoretical and empirical analysis, this study proposes the following hypothesis:

H1: Elementary mathematics teachers' emotional expression has a significant positive predictive effect on student academic engagement.

The Mediating Role of Students' Academic Self-Efficacy

A substantial body of empirical work has established a robust positive association between students' academic self-efficacy and their learning engagement across varied educational settings (Meng & Zhang, 2023). Drawing on Bandura's (1977) theoretical framework, learners with high self-efficacy typically exhibit stronger achievement motivation, greater persistence when facing challenges, and more adaptive use of learning strategies (Wang & Tambi, 2024). Such students are also more inclined to set ambitious academic goals, a tendency that further reinforces their competitive orientation and active classroom involvement.

The stability of this relationship has been confirmed in cross-contextual studies. For instance, research involving military academy students demonstrates that even within high-stress environments, academic self-efficacy retains its predictive power regarding engagement, albeit modulated by academic pressure (Yao, 2015). These findings not only affirm the generalizability of the mechanism but also clarify how environmental factors may define its boundaries. This aligns with Bandura's (1977) proposition that learners with high self-efficacy, propelled by heightened achievement motivation, tend to embrace more challenging tasks. The inherent difficulty of these tasks subsequently activates their competitive drive, thereby elevating engagement.

Recent scholarship has further illuminated the underlying mechanisms. Lin Jie et al. (2020) identified three distinct pathways linking high self-efficacy to engagement: cognitively, it promotes deeper information processing; affectively, it bolsters psychological resilience; and behaviour ally, it encourages proactive help-seeking and exploration. This multidimensional model offers a comprehensive lens through which to understand how self-efficacy operates. Despite these advances, notable gaps remain. First, the integrated mechanism connecting teacher emotional support, self-efficacy, and engagement lacks sufficient exploration. Second, empirical studies quantitatively testing these mediation pathways are still scarce. Guided by the theoretical perspective that environmental influences shape self-perceptions, which in turn drive behaviour (Bandura, 1997; Pianta et al., 2012), teacher emotional support may serve as a pivotal environmental input that enhances self-efficacy, thereby fostering greater engagement. This study addresses this gap by proposing a complete influence chain wherein teacher emotional expression impacts engagement via self-efficacy—a model with significant theoretical and practical implications for educational interventions. Based on the preceding review, we propose:

H2: Students' academic self-efficacy mediates the relationship between teachers' emotional expression and students' academic engagement.

The Moderating Role of Teacher Digital Literacy

Within the mechanism linking elementary mathematics teachers' emotional expression to student academic engagement, student self-efficacy serves as a critical

mediator. Student self-efficacy refers to learners' beliefs in their capacity to successfully accomplish specific mathematics learning tasks (Bandura, 1978). However, against the backdrop of widespread digital instruction, the strength of self-efficacy's positive impact on engagement largely depends on the level of teacher digital literacy. Teacher digital literacy encompasses not only basic technical operational skills but also higher-order capabilities such as evaluating digital instructional resources, organizing online collaborative activities, and utilizing technology to solve pedagogical problems (MUJTAHID et al., 2021). Teachers with higher digital literacy are better positioned to optimize instructional design using digital tools, manage classroom dynamics, and foster productive teacher-student interactions (Liu et al., 2023).

This foundation of competence enhances teachers' sense of instructional control and preparedness when facing digital teaching challenges, enabling them to more effectively translate student self-efficacy into tangible academic engagement. Research by Jaya and Nurqamarani (2023) demonstrates that teacher digital literacy and primary students' academic self-efficacy jointly play a vital role in fostering engagement within blended learning environments. Empirical evidence supports this moderating mechanism; Wang et al. (2024), in a vocational education context, found that teacher support—including emotional, learning, and instrumental support—positively predicted information literacy through the mediating role of teacher self-efficacy.

Notably, teacher digital literacy appears to exert an "amplifying effect" rather than a "compensatory effect." Even if students possess high mathematical self-efficacy beliefs, their actual engagement will remain constrained if teachers lack the corresponding digital skills to provide high-quality instructional scaffolding. Conversely, a positive alignment occurs when teachers possess high digital literacy and students exhibit high self-efficacy, allowing students to fully capitalize on the supportive resources generated by teacher emotional expression. Based on this analysis, this study proposes the following hypothesis:

H3: Teacher digital literacy moderates the mediating effect of student self-efficacy on the relationship between teacher emotional expression and student academic engagement.

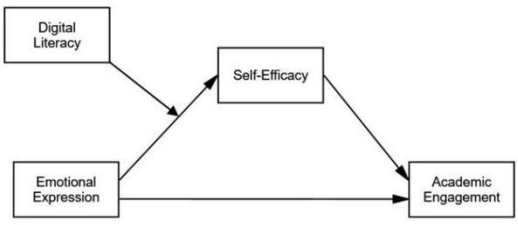


Figure 1. The Proposed Model

III. METHOD

Procedure and Participants

This study adopted a multi-stage cluster random sampling design across Jilin Province, China. First, four cities were randomly selected—Changchun, Jilin City, Siping, and Liaoyuan—to capture regional variations in educational resources. From each city, four primary schools were randomly chosen, resulting in a final sample of 16 schools. Rather than surveying teachers directly, we administered student-report questionnaires, as students serve as reliable perceivers of classroom emotional climates over time. Participants were 423 fourth- to sixth-grade students (aged 9–12). We focused on upper elementary grades because these students possess sufficient cognitive maturity to evaluate teacher behaviour s and self-report on abstract constructs like self-efficacy and digital literacy. Additionally, mathematics instruction becomes increasingly specialized at this stage, making teacher emotional expression more salient. Data collection occurred during October and November 2025. Questionnaires were group-administered in classrooms under standardized conditions, with trained research assistants clarifying items but not influencing responses. Parental informed consent was obtained prior to participation. Of the 423 questionnaires returned, 400 were deemed valid after excluding invalid responses, yielding a valid response rate of 94.6%. The final sample included 208 boys (52.0%) and 192 girls (48.0%). Ethical approval was granted by the Institutional Review Board of the authors' university.

Measurements

The measurement of dimension for teacher's emotional expression in preservice math teacher education was adopted Wei and Xu (2022), comprised four 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 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 measure.

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.

Digital literacy was assessed using the 22-item scale developed by (Shen, 2022), which has demonstrated robust psychometric properties in Chinese higher education contexts. The instrument captures six core dimensions: tools and technology, information literacy, communication, content creation, safety, and problem-solving. Participants responded to items on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores reflecting greater digital literacy competence. A representative item is: "I can understand the basic knowledge and methods of information retrieval and accurately obtain the required information." Confirmatory factor analysis supported a six-factor structure with acceptable fit indices (NFI = 0.905, CFI = 0.921, TLI =

0.906, RMSEA = 0.096). Internal consistency was excellent, with Cronbach's α values ranging from 0.766 to 0.941 across dimensions and 0.970 for the full scale.

Data Analysis Strategy

Data preparation and analysis followed a three-step procedure. Initially, descriptive statistics were computed for all key variables to summarize the sample characteristics. Subsequently, bivariate Pearson correlations were estimated to explore the linear associations among teachers' emotional expression, student academic engagement, self-efficacy, and digital literacy. To rigorously test the hypothesized moderated mediation model, we employed PROCESS macro for SPSS (Hayes, 2017). Specifically, Model 4 was first used to assess the simple mediating role of self-efficacy. Following this, Model 7 was utilized to examine the conditional indirect effect, testing whether digital literacy moderates the path from teachers' emotional expression to student self-efficacy. To determine the significance of the indirect effects, we applied a bias-corrected bootstrap method with 5,000 resamples. The confidence intervals (CIs) were set at 95%; any indirect effect whose CI did not include zero was considered statistically significant. All statistical operations were executed using SPSS version 26.0.

IV. FINDINGS

Common Method Bias Test

Since all key variables were self-reported by students, we ran Harman's single-factor test to rule out common method bias. All items were loaded into an unrotated principal component analysis—the first factor accounted for just 27.3% of total variance, far below the 50% cutoff (Podsakoff et al., 2003). We also compared a single-factor confirmatory model against our proposed four-factor structure. The four-factor model fit significantly better ($\chi^2/df = 2.18$, CFI = 0.94, TLI = 0.93, RMSEA = 0.05) than the single-factor alternative ($\chi^2/df = 6.02$, CFI = 0.69, TLI = 0.66, RMSEA = 0.13). These results indicate no severe common method bias in the data.

Descriptive Statistics

Table I presents the demographic profile of the 400 participating students, drawn from 16 primary schools across four cities in Jilin Province. The sample consisted of 208 boys (52.0%) and 192 girls (48.0%), reflecting a balanced gender distribution. Participants were drawn from the upper elementary grades, with 138 fourth-graders (34.5%), 132 fifth-graders (33.0%), and 130 sixth-graders (32.5%). The mean age was 10.86 years (SD= 1.12).

Consistent with the multi-stage cluster random sampling design, four schools were randomly selected from each city (two urban, two suburban/rural). While we aimed to collect 25 questionnaires per school, minor variations occurred due to student absences and incomplete responses. As illustrated in the table, the final distribution shows a slightly higher representation from urban schools (n = 212, 53.0%) compared to suburban/rural schools (n = 188, 47.0%), a natural outcome of field data collection. The sample provides robust representation across the diverse educational landscapes of Jilin Province.

TABLE I DEMOGRAPHIC CHARACTERISTICS

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	208	52
	Female	192	48
Grade Level	Grade 4	138	34.5
	Grade 5	132	33
	Grade 6	130	32.5
City & School Type	Changchun (Urban)	56	14
	Changchun (Suburban/Rural)	47	11.8
	Jilin City (Urban)	54	13.5
	Jilin City (Suburban/Rural)	49	12.3
	Siping (Urban)	53	13.3
	Siping (Suburban/Rural)	46	11.5
	Liaoyuan (Urban)	49	12.3
	Liaoyuan (Suburban/Rural)	46	11.5
Age (Years)	M (SD)	10.86 (1.12)	
	Range	9-12	

Correlation Analysis

As shown in Table II, Pearson correlation analysis revealed significant positive associations among most key variables, providing initial support for the hypothesized model. Teachers' emotional expression (TEE) was significantly and positively correlated with students' self-efficacy (SASE, r= .413, p< .01) and student academic engagement (SAE, r= .508, p< .01). Consistent with expectations, SASE also exhibited a strong positive correlation with SAE (r= .562, p< .01).

Notably, digital literacy (DL) demonstrated a substantial positive correlation with SASE (r= .469, p< .01) and a weaker, yet significant, positive correlation with SAE (r= .247, p< .01). Interestingly, DL was not significantly correlated with TEE (r= .007, p> .05). This absence of a direct link between TEE and DL suggests that students' digital literacy operates independently of the level of teacher emotional expression they perceive, thereby strengthening the rationale for examining DL as a pure moderator rather than a covariate in the subsequent moderated mediation analysis.

TABLE II CORRELATION ANALYSIS

	TEE	DL	SASE	SAE
TEE	1			
DL	.007	1		
SASE	.413**	.469**	1	
SAE	.508**	.247**	.562**	1

Mediating Role of Self-Efficacy

The analysis using PROCESS Model 4 revealed a significant total effect of teachers' emotional expression (TEE) on student academic engagement (SAE) (B= 0.387,

SE= 0.033, 95% CI [0.322, 0.452]). When students' self-efficacy (SASE) was entered as a mediator, the direct effect of TEE on SAE remained significant (B= 0.253, SE= 0.032, 95% CI [0.190, 0.317]), indicating a partial mediation. More importantly, the indirect effect via SASE was significant (B= 0.134, Boot SE= 0.024, 95% CI [0.088, 0.182]), accounting for approximately 34.6% of the total effect. Since the confidence intervals for both the direct and indirect effects did not include zero, these results provide robust evidence that students' self-efficacy serves as a significant partial mediator in the relationship between teachers' emotional expression and student academic engagement.

TABLE III MAIN AND MEDIATION EFFECTS

Path	Effect	BootSE	BootLLCI	BootULCI
Direct effect*	0.253	0.032	0.19	0.317
Indirect effect	0.134	0.024	0.088	0.182
Total effect	0.387	0.033	0.322	0.452

Test of the Moderated Mediation Effect

The results from the moderated mediation analysis (PROCESS Model 7) are summarized in Table IV. For Model 1, the interaction term TEE × DL was significantly negative (B= -0.154, p< .001), explaining an additional 11% of the variance (ΔR^2= 0.11). This indicates that teachers' digital literacy acts as a suppressor moderator. Probing the interaction revealed that the positive effect of teachers' emotional expression (TEE) on students' self-efficacy (SASE) was strongest when teachers possessed lower digital literacy (simple slope = 0.414, p< .001). Conversely, this effect was attenuated for teachers with higher digital literacy (simple slope = 0.040, p< .05).

Model 2 confirmed that students' self-efficacy strongly predicted their academic engagement (B= 0.557, p< .001). The direct effect of TEE on engagement remained significant (B= 0.253, p< .001). These findings suggest that while teachers' emotional expression generally fosters engagement via self-efficacy, this mechanism is contingent upon teachers' technological proficiency. Students may rely less on teachers' emotional cues to feel efficacious in classrooms where teachers demonstrate high digital literacy.

TABLE IV TEST OF THE MODERATED MEDIATION EFFECT

Predict variable	Model 1 (Self efficacy)						Model 2 (Student Academic Engagement)					
	Coefficient	SE	T	p	LLCI	ULCI	Coefficient	SE	T	p	LLCI	ULCI
TEE	0.844	0.071	11.851	<0.001	0.704	0.984	0.253	0.032	7.833	<0.001	0.190	0.317
DL	0.86	0.07	12.306	<0.001	0.723	0.998						
SASE							0.557	0.056	10.013	<0.001	0.446	0.668
TEE X DL	-0.154	0.017	-9.132	<0.001	-0.187	-0.121						
R^2	0.477						0.408					
F	120.354***						136.554***					
ΔR (TEE X DL)	0.11											
F (TEE X DL)	83.399***											

V. DISCUSSION

The present study sought to unpack the mechanisms linking elementary mathematics teachers' emotional expression to student academic engagement, with a specific focus on the mediating role of student self-efficacy and the moderating role of teacher digital literacy. Our findings largely corroborate the theoretical framework posited by Social Cognitive Theory (Bandura, 1997), yet they also reveal nuanced boundary conditions that challenge conventional assumptions about the universal benefits of teacher emotion in digitalized classrooms.

First, the results confirmed that student self-efficacy serves as a significant partial mediator. The indirect effect accounted for approximately 34.6% of the total effect, indicating that teachers' emotional expression not only directly stimulates engagement but also operates by bolstering students' beliefs in their mathematical capabilities. This aligns with recent scholarship emphasizing that positive teacher affects functions as a form of social persuasion, helping to alleviate the chronic anxiety often associated with mathematics learning (Frenzel, 2014). However, a critical perspective suggests that this mediation is not ubiquitous. Some researchers argue that in certain cultural contexts, overly expressive teaching might be perceived as a lack of content mastery, potentially diluting the rigor of mathematics instruction (Jiang et al., 2021). The fact that a significant direct path remained suggests that engagement is also driven by factors outside of self-perception, such as intrinsic motivation or classroom structure, which were not captured in this model.

More intriguingly, the moderated mediation analysis revealed a counterintuitive suppression effect of teacher digital literacy. Contrary to the expectation that technology integration would amplify the positive effects of emotional expression (Li et al., 2021), our findings showed that the path from TEE to SASE was strongest when teachers had lower digital literacy and weakest when they had higher digital literacy. One plausible explanation is that in technologically advanced classrooms, the teacher's role shifts from being the primary emotional anchor to a facilitator of digital interactions. High digital literacy may enable teachers to create automated, engaging learning

environments where emotional cues are embedded in the software rather than solely expressed by the teacher (McGuinness & Fulton, 2019). Consequently, students may rely less on the teacher's immediate emotional demeanor to feel efficacious. Conversely, in low-digital-literacy contexts, the teacher's emotional expression becomes a crucial compensatory tool for maintaining student motivation and self-belief (Runge et al., 2023). This finding challenges the simplistic narrative that "more technology is always better" and instead highlights the need for a balanced integration of affective and digital competencies.

VI. LIMITATION

Several limitations warrant attention. First, the sole reliance on student self-report questionnaires introduces potential common method bias, despite our efforts to mitigate it statistically. Students' perceptions of teacher behaviour are inherently subjective; a student who generally likes math might rate their teacher's emotional expression higher simply because they enjoy the class, regardless of the teacher's actual demeanor. Future studies would benefit from multi-source data, such as classroom observations or teacher self-assessments, to triangulate these findings.

Second, the cross-sectional design limits causal inferences. Although the moderated mediation model implies directionality, we cannot definitively conclude that teacher emotional expression causes changes in self-efficacy over time. It is plausible that students with higher baseline self-efficacy are more attuned to perceiving positive emotions from their teachers. Longitudinal or experimental designs are needed to establish temporal precedence and causal relationships.

Finally, the generalizability of the findings may be constrained by the sampling frame. The sample was drawn exclusively from Jilin Province, a region with specific socioeconomic and educational characteristics in northeastern China. Given the vast disparities in educational resources between urban and rural areas in China, the moderating role of digital literacy might manifest differently in coastal or western regions. Replicating this study in more diverse cultural and socioeconomic contexts is essential to validate the robustness of the model.

VII. CONCLUSION

This study advances our understanding of how elementary mathematics teachers' emotional expression translates into student engagement within digitally enhanced classrooms. We found that students' self-efficacy serves as a vital bridge, partially explaining the link between teacher affect and engagement. However, the most compelling insight lies in the moderating role of teacher digital literacy. Counter to the assumption that technology uniformly amplifies teaching effectiveness, our findings suggest that high digital literacy may actually buffer the need for overt emotional expression; in classrooms rich with technological scaffolding, the teacher's emotional demeanor becomes a less critical driver of student self-efficacy.

For practitioners, these results underscore the need for a balanced professional development approach. Simply encouraging teachers to be more emotionally expressive may not be a one-size-fits-all solution. Schools should invest in improving teachers' digital literacy to create structured, engaging learning environments, while simultaneously training teachers to deploy emotional expression strategically, particularly in contexts where technological resources are limited. Ultimately, fostering student engagement requires a synergistic blend of affective presence and technological proficiency.

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