African Educational Research Journal
Vol. 14(3), pp. 514-527, July 2026
ISSN: 2354-2160
Full Length Research Paper

Exploring the relationship among mathematics self-efficacy, mathematics teaching self-efficacy, mathematics anxiety and instructional practices: Moderating role of school climate

Boniface Aabeyir*, Ebenezer Bonyah and Ernest Larbi

University of Skills Training and Entrepreneurial Development, Ghana.

Accepted 9 July, 2026

ABSTRACT

This study sought to examine the relationships among mathematics self-efficacy, mathematics teaching self-efficacy, mathematics anxiety, and instructional practices of senior high school mathematics teachers in the Ashanti Region of Ghana, while assessing the moderating role of school climate. Using validated scales to collect data from 443 teachers and analyzing the data using partial least squares structural equation modelling, the results showed that mathematics self-efficacy and mathematics teaching self-efficacy significantly improved mathematics teachers' instructional practices. Though mathematics anxiety had a negative effect on instructional practices, the effect was found not to be statistically significant. The results further indicated that school climate and mathematics self-efficacy are significant predictors of mathematics teaching self-efficacy. Additionally, school climate was found not to significantly strengthen or weaken the relationship between mathematics self-efficacy and instructional practices, or the relationship between mathematics anxiety and instructional practices. Also, the results showed that the relationship between mathematics self-efficacy and mathematics teaching self-efficacy was not strengthened by school climate. These findings highlight that teachers' efficacy beliefs are the most consistent drivers of instructional practices, while school climate indirectly contributes by strengthening teaching self-efficacy. The implications for practice are that professional development initiatives should prioritize building mathematics teachers' self-efficacy, as this is directly linked to improved instructional effectiveness. Additionally, fostering a supportive school climate can reinforce teaching self-efficacy, thereby indirectly enhancing instructional practices. While reducing anxiety remains important for teacher well-being, it may not independently influence classroom practices unless combined with efficacy-building and climate-support strategies. This evidence underscores the central role of efficacy beliefs, supported by positive school environments, in shaping effective mathematics instruction in Ghanaian senior high schools.

Keywords: Mathematics anxiety, mathematics self-efficacy, mathematics teaching self-efficacy, school climate, instructional practices.

*Corresponding author. E-mail: bybaabeyir@gmail.com.

INTRODUCTION

Effective mathematics instruction is essential for equipping learners with the knowledge and skills needed to thrive in a rapidly evolving, technology-driven world. Teachers play a critical role in determining how mathematical concepts are presented and understood by learners (Klusmann et al., 2021; Lazarides et al., 2020). Consequently, researchers have increasingly focused on psychological factors such as mathematics self-efficacy, mathematics teaching self-efficacy, and mathematics anxiety as key determinants of instructional quality. Teachers with high self-efficacy demonstrate greater confidence in their abilities, employ diverse instructional strategies, and create learning environments that enhance learner engagement and achievement (Burić and Kim, 2020). In contrast, mathematics anxiety can undermine effective instruction by causing teachers to avoid complex topics, limit learner participation, and adopt less interactive teaching approaches (Foley et al., 2019; Zhang et al., 2019). These psychological factors are further influenced by contextual conditions such as school climate, which may either support or hinder effective teaching practices.

Recent studies have distinguished between mathematics self-efficacy and mathematics teaching self-efficacy, emphasizing that confidence in solving mathematical problems does not necessarily translate into confidence in teaching mathematics effectively (Skaalvik and Skaalvik, 2020). Mathematics teaching self-efficacy influences teachers' selection of instructional strategies, classroom management practices, and willingness to adopt innovative teaching methods (Lazarides et al., 2020). Teachers with high teaching self-efficacy are more likely to implement learner-centered approaches, integrate technology into instruction, and adapt lessons to meet diverse learning needs. Conversely, teachers with low teaching self-efficacy often rely on teacher-centered methods and encourage rote memorization rather than conceptual understanding. Research suggests that self-efficacy beliefs are shaped by prior experiences, professional training, and institutional support systems (Klusmann et al., 2021), highlighting the importance of examining both forms of self-efficacy in understanding mathematics instructional practices. Mathematics anxiety remains a significant challenge in mathematics education. Teachers experiencing high levels of anxiety are more likely to avoid difficult mathematical content, provide fewer opportunities for learner engagement, and demonstrate reduced instructional flexibility (Foley et al., 2019; Zhang et al., 2019). Anxiety is closely linked to self-efficacy, as teachers with lower confidence in their abilities tend to experience greater levels of worry and stress, which may negatively affect their instructional behavior (Pekrun et al., 2019). Furthermore, teacher anxiety can indirectly influence learners' attitudes and achievement by transmitting negative perceptions of mathematics. Addressing mathematics anxiety is, therefore, essential for improving instructional quality and learner outcomes.

In addition to psychological factors, school climate has been identified as an important contextual influence on teachers' instructional practices (Collie et al., 2020; Wang and Degol, 2020). A positive school climate characterized by supportive leadership, collegial collaboration, access to resources, and a conducive teaching environment can enhance teacher motivation, strengthen self-efficacy, reduce stress, and encourage innovative instructional practices. Conversely, an unsupportive school climate may increase anxiety, weaken self-efficacy, and limit teachers' willingness to adopt effective instructional approaches. Recent evidence suggests that school climate may strengthen the positive effects of self-efficacy while reducing the negative influence of anxiety on instructional practices (Wang and Degol, 2020). Therefore, school climate functions not only as a contextual factor but also as a potential moderator of teachers' instructional behaviors.

Even though the factors, teacher self-efficacy, mathematics anxiety, and instructional practices have been widely explored, there still exist important gaps. Existing literature links teacher self-efficacy to instructional quality, but many teachers still lack confidence in teaching, especially complex mathematical concepts (Klusmann et al., 2021; Lazarides et al., 2020). Mathematics anxiety also undermines teaching effectiveness and learner outcomes (Foley et al., 2019; Zhang et al., 2019). However, most studies have examined these factors separately, offering limited evidence of their combined influence on instructional practices. The moderating role of school climate on the relationships among psychological factors has not been explored. While supportive environments are known to enhance teacher motivation and effectiveness (Collie et al., 2020; Wang and Degol, 2020), little is known about how school climate interacts with psychological factors, such as mathematics self-efficacy, mathematics teaching self-efficacy and mathematics anxiety, to shape instructional behaviour of teachers. Moreover, the reliance on the simple regression technique as a statistical tool to analyze the relationships among these psychological factors has restricted insights into the complex direct, indirect, and moderating relationships among these variables (Burić and Kim, 2020; Hair et al., 2021).

In filling these gaps, this study looks into how mathematics self-efficacy, mathematics teaching self-efficacy, and mathematics anxiety influence instructional practices, while considering the moderating role of school climate. By making use of partial least squares structural equation modeling (PLS-SEM), the study aims to provide a comprehensive framework for understanding the interplay of psychological and contextual factors in mathematics instruction.

Purpose of the study

The study primarily sought to investigate the interrelationships among mathematics self-efficacy, mathematics teaching self-efficacy, mathematics anxiety and instructional practices of teachers in the selected senior high schools in the Ashanti Region of Ghana. Also, this study sought to determine the extent to which school climate strengthens the positive influence of self-efficacy and ameliorates the negative effects of mathematics anxiety on instructional practices of mathematics teachers in the region.

Specifically, this research sought to:

i. Determine the direct effects of mathematics self-efficacy on instructional practices.
ii. Find out the direct impact of mathematics teaching self-efficacy on the instructional practices of teachers.
iii. Investigate the impact of mathematics anxiety on instructional practices.
iv. Determine the moderating role of school climate on the relationships between teacher psychological factors (self-efficacy and anxiety) and instructional practices.

LITERATURE REVIEW

Theoretical framework

The theoretical framework underpinning this study is the Social Cognitive Theory by Albert Bandura. It lays emphasis on self-efficacy behavior, motivation and performance. Teachers' confidence in their abilities shapes how they tackle challenging tasks, persevere through difficulties and implement instructional strategies. School factors or other environmental factors can promote or impede the demonstration of self-efficacy. Mathematics anxiety is seen as an emotional obstacle impacting teachers' sense of control and instructional practices. Bandura's Social Cognitive Theory offers a perspective for understanding how personal and contextual factors together influence instructional practices of mathematics teachers.

Conceptual framework and hypothesis development

The conceptual framework is grounded in theory and empirical evidence illustrating the hypothesized connections among the variables, as shown in Figure 1.

The framework incorporates personal psychological and contextual variables to offer a comprehensive understanding of what shapes instructional practices. Within the model, mathematics self-efficacy and mathematics teaching self-efficacy are conceptualized as key drivers of instructional practices. Mathematics self-efficacy relates to teachers' confidence in their own mathematics knowledge, whereas mathematics teaching self-efficacy concerns their belief in their capacity to provide effective mathematics instruction. Teachers with strong self-efficacy tend to adopt innovative instructional strategies, persevere through difficulties and create engaging classroom environments. Therefore, both constructs are anticipated to positively affect instructional practices.

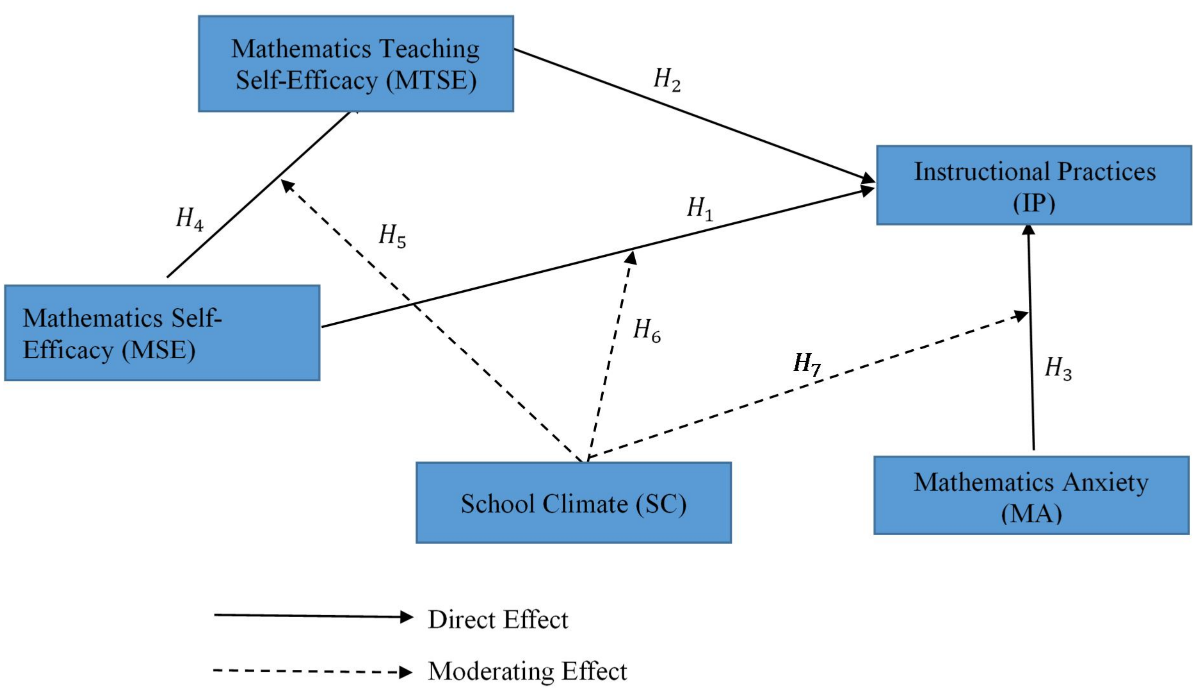

Figure 1. Conceptual framework of the study.

Conversely, mathematics anxiety is viewed as a negative psychological factor that can impede effective teaching. High mathematics anxiety among teachers can lead to avoidance of challenging content, reliance on suboptimal teaching methods, and reduced instructional confidence. Accordingly, mathematics anxiety is anticipated to negatively influence instructional practices. The framework also proposes a direct relationship between mathematics self-efficacy and mathematics teaching self-efficacy. Teachers who feel confident in their mathematics skills are more likely to believe they can teach mathematics effectively, indicating a positive relationship between the two. In addition, school climate is integrated as a moderator. School climate refers to the general condition of the school environment, including support among colleagues, leadership quality, and access to resources. A healthy school atmosphere tends to enhance self-confidence and reduce the harmful effects of anxiety. Specifically, the school climate changes the strength of three relationships: between mathematics self-efficacy and instructional practices, between mathematics anxiety and instructional practices and between mathematics self-efficacy and teachers' confidence in teaching mathematics. The integrated model makes it possible to analyze both direct and moderating effects through PLS-SEM, offering a reliable way to study how the psychological factors and the contextual factors affect instructional practices.

Using the framework as a basis, the following hypotheses are formulated:

H_1**:** Mathematics self-efficacy has a significant positive impact on instructional practices

H_2**:** Mathematics teaching self-efficacy has a significant positive effect on instructional practices.

H_3 **:** Mathematics anxiety has a significant negative influence on instructional practices.

H_4**:** Mathematics self-efficacy has a significant positive impact on mathematics teaching self-efficacy.

H_5: School climate has a direct effect on mathematics teaching self-efficacy.

H_6**:** School climate moderates the relationship between mathematics self-efficacy and instructional practices, such that the relationship is stronger under a positive school climate.

H_7**:** School climate moderates the relationship between mathematics anxiety and instructional practices such that the negative effect is weaker under a positive school climate.

H_8**:** School climate moderates the relationship between mathematics self-efficacy and mathematics teaching self-efficacy such that the relationship is stronger under a positive school climate.

Empirical review

Existing studies consistently underscore the important role of teacher self-efficacy in improving mathematics instruction. It is revealed that high self-efficacy is connected with persistence in problem-solving and resilience in challenging classroom situations, which leads teachers to embrace learner-centered strategies that promote inquiry and collaboration (Burić and Kim, 2020; Klusmann et al., 2021). Conversely, low self-efficacy often results in reliance on traditional, teacher-centered methods that limit student engagement (Lazarides et al., 2020). What emerges across these studies is not merely a correlation but a dynamic interplay: teachers' confidence in their instructional skills directly influences the extent to which they embrace innovative teaching practices that promote critical thinking.

Self-efficacy does not operate in isolation. It is shaped by prior experiences, easy access to professional development, and the availability of resources (Skaalvik and Skaalvik, 2020). At the same time, it interacts with psychological factors such as motivation and anxiety, suggesting that professional training alone might not be sufficient unless it also addresses the emotional dimensions of teaching. For instance, mathematics anxiety weakens both mathematics self-efficacy and mathematics teaching self-efficacy, creating a feedback loop where low confidence heightens anxiety, which in turn restricts instructional flexibility (Pekrun et al., 2019; Zhang et al., 2019). Anxiety is not limited to teachers themselves only, but it can be transmitted to learners through excessively cautious or avoidance-based teaching strategies, thereby reducing classroom interaction and achievement (Foley et al., 2019; Zhang et al., 2019). Evidence suggests that professional development and supportive school environments can improve anxiety and strengthen instructional practices (Burić and Kim, 2020).

The school climate further complicates this picture by moderating the relationship between psychological factors and instructional practices. Supportive environments are characterized by collaboration, autonomy, and resource availability, which enable teachers to leverage their psychological strengths, reducing stress and fostering innovation (Collie et al., 2020; Wang and Degol, 2020). In opposition, an unsupportive school climate worsens anxiety and limits instructional adaptability. This suggests that interventions targeted at enhancing teaching practices must not take into account only individual teacher characteristics but also the broader institutional context in which they operate.

In totality, the literature suggests that mathematics instructional practices are best understood as the outcome of a complex system in which self-efficacy, anxiety, and school climate interact. Effective teaching strategies that include inquiry-based and collaborative methods of teaching are more likely to emerge when teachers feel confident, supported, and emotionally secure (Burić and Kim, 2020; Lazarides et al., 2020). Conversely, when anxiety is high and school climate is unsupportive, teachers gravitate toward orthodox methods that hinder learner innovativeness, participation and performance (Skaalvik and Skaalvik, 2020; Foley et al., 2019). Large-scale assessments such as PISA 2022 give more details that teaching practices play a role in linking teacher characteristics to learners' performance (OECD, 2023). This synthesis emphasizes the need for professional development programmes that, at the same time, strengthen self-efficacy, reduce anxiety, and cultivate supportive school environments, integrated approaches essential for transforming teacher characteristics into classroom practices that promote students' learning outcomes.

METHODS

Using a quantitative cross-sectional design, this study investigated the direct relationships among mathematics self-efficacy, mathematics teaching self-efficacy, mathematics anxiety and mathematics teachers' instructional practices with school climate serving as a moderating variable. The use of the cross-sectional design made it possible to measure all variables at the same time and to analyze both direct and moderating effects through the use of partial least squares structural equating modelling (PLS-SEM) (Hair et al., 2021). This method was well-suited to explore the intricate relationships between latent variables and evaluate the proposed conceptual model.

The study population consisted of senior high school mathematics teachers in the Ashanti Region of Ghana. Using a stratified random sampling, 450 teachers were chosen to guarantee adequate representation of category A, B and C schools and across urban and rural areas, as all participating teachers were informed about the purpose of the study, their right to participate voluntarily and could withdraw at any time without penalty, and the measures taken to ensure the confidentiality and anonymity of their responses. On the inclusion criteria requirement, only teachers with a minimum of one year of teaching experience in mathematics were eligible to participate in the study. According to the PLS-SEM guidelines, the selected sample size is adequate as it exceeds the minimum requirement of ten times the number of indicators in the most complex constructs, ensuring sufficient statistical power (Hair et al., 2021).

Data were collected using a structured questionnaire adapted from previously validated instruments. The questionnaire comprised six sections covering demographic characteristics, mathematics self-efficacy, mathematics teaching self-efficacy, mathematics teaching anxiety, instructional practices, and school climate. Mathematics self-efficacy, defined as teachers' confidence in understanding and solving mathematical problems, was measured using the Mathematics Self-Efficacy Scale developed by Burić and Kim (2020). Mathematics teaching self-efficacy was assessed using the Mathematics Teaching Self-Efficacy Scale developed by Skaalvik and Skaalvik (2020), while mathematics teaching anxiety was measured using the Mathematics Teaching Anxiety Scale (MTAS) developed by Sari (2014) and further applied by Foley et al. (2019). Teachers' instructional practices were measured using the Patterns of Adaptive Learning Scales (PALS) developed by Midgley et al. (2000), and school climate was assessed using the School Climate Questionnaire (SCQ) for teachers developed by Pyper et al. (1987). To make sure of contextual relevance for senior high school mathematics teachers in Ghana, the wording of the measurement items of the adapted scales was carefully revised to reflect the local educational context while maintaining the original intended meaning of constructs. The adapted questionnaire was reviewed independently by two experts in mathematics education to evaluate the relevance, clarity, and cultural appropriateness of the items. The feedback from the experts resulted in a few modifications to the wording of the item and instructions to improve clarity and contextual suitability. The revised instrument was then pilot-tested with 30 senior high school mathematics teachers in the Ashanti Region. The pilot study confirmed that the questionnaire items were clear and understandable and demonstrated satisfactory reliability and content validity, supporting their use in the main study. Previous studies have also reported strong internal consistency for the original instruments, with Cronbach's alpha coefficients not below 0.80. All questionnaire items were measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

RESULTS

Demographic information of respondents

Examining the demography of the participants is important for interpreting study findings and evaluating how age, gender, teaching experience and educational qualification might impact mathematics anxiety, self-efficacy and instructional practices. Although the study initially involved 450 participants, 443 participants from schools in the Ashanti Region were included in the final analysis due to errors and incomplete responses.

Table 1 presents the demographic characteristics of the 443 participants who provided useful background context for the study outcomes.

Table 1. Demographic profile of respondents.

Demographic variable	Frequency	Percentage
Gender		
Male	389	87.8
Female	54	12.2
Age		
Under 25	35	7.6
25-34	138	31.1
35-44	155	35.0
45-54	85	19.2
55 or older	30	6.8
Years of teaching experience		
Less than 1 year	22	5.05
1-3 years	91	20.5
4-6 years	110	24.8
7-9 years	95	21.5
More than 9 years	155	35.0
Highest level of education		
Bachelor's Degree	212	47.9
Postgraduate Diploma	108	24.4
Master's Degree	116	26.2
Doctorate (PhD)	5	1.1
School category		
Category A	72	16.2
Category B	225	50.8
Category C	146	33.0

Majority of the participants were males, accounting for 389 teachers (87.8%), whereas 54 teachers (12.2%) were female, suggesting a largely male teaching population. The age distribution of respondents reflects a diversity of career stages. The table reveals that 7.9% were younger than 25 years, 31.1% fell within 25 to 34 years, and 35.0% were in the 35-44 age group, 19.2% of the participants were aged between 45 and 54 years, and 6.8% were aged 55 years or older. This suggests a significant presence of mid-career teachers supported by both less experienced and veteran staff. On teaching experience in mathematics, it is revealed that 5.0% of the teachers had less than one year of experience, 20.5% had one to three years, 24.8% had four to six years, 21.5% with seven to nine years, and 35% had over nine years. This indicates that the study included both relatively novice and relatively experienced teachers. Touching on educational attainment, it is indicated that 47.9% of the participants held Bachelor's degrees, 24.4% had postgraduate diplomas or certificates, 26.2% were master's degree holders, while 1.1% held a Doctorate. With regards to the number of years participants have been teaching in their present school, 6.3% of the participants indicated that their length of stay in their current schools is less than one year, 23.7% indicated that they have been teaching in their current schools between one and three years, 30.5 have their length of stay in their present schools to between four and six years with a greater number indicating that they have been teaching in their current schools over six years. In addition, the school category distribution shows that 16.2 of the participating teachers were from category A schools, a large proportion representing 50.8 of the participants from category B and 33.0% from category C schools.

In all, the information in Table 1 indicates a predominantly male workforce with diverse age groups, a wide range of teaching experience, strong academic qualifications, and representation from schools with varying resources. These characteristics provide a comprehensive context for analyzing mathematics teaching anxiety, self-efficacy, and instructional practices among senior high school mathematics teachers in the Ashanti Region.

Measurement items deletion criteria

As a preliminary requirement of the PLS-SEM analysis, the measurement items of each construct were subject to deletion and retention criteria. The values of factor loadings determine whether an item would be deleted or retained. A factor loading is simply the correlation between the measurement items and the latent constructs (Hair et al., 2019; Kline, 2016). A high factor loading indicates that the item reflects the construct. For PLS-SEM, items with loadings below 0.40 are usually considered for removal to enhance measurement quality and model fit (Kline, 2016).

Initially, nine measurement items were adapted for each construct. From Table 2, out of the nine adapted measurement items for mathematics anxiety and mathematics self-efficacy, four were retained for each construct. Similarly, for mathematics teaching, self-efficacy and school climate, three items were also retained for each construct, while five were retained for instructional practices.

Table 2. Retained measurement items with loadings.

Measurement items	Factor loadings
Mathematics Anxiety	
MA1: I feel nervous when a pre-service/trainee teacher observes my mathematics teaching.	0.840
MA3: I feel tense while solving math problems on the board in front of the class.	0.803
MA4: I avoid classroom discussion in case students pose difficult maths questions.	0.716
MA5: I feel uncomfortable when one of my colleagues comes to my classroom during a mathematics lesson.	0.840
Mathematics Self-Efficacy	
MSE 2: I can solve algebraic equations without using a calculator.	0.683
MSE 4: I can understand and solve problems involving fractions and decimals.	0.635
MSE 7: I can apply math concepts to real-world situations.	0.752
MSE 8: I can accurately interpret graphs and tables to solve problems.	0.781
Mathematics Teaching Self-Efficacy (MTSE)	
MTSE 2: I am confident in explaining complex word problems to students.	0.801
MTSE6: I can effectively teach mathematical concepts such as ratios and proportions.	0.790
MTSE 7: I am confident in designing lessons that cover key algebraic concepts.	0.814
School Climate (SC)	
SC 2: Most teachers in this school believe that the students’ well-being is important.	0.867
SC 3: Most teachers in this school are interested in what students have to say.	0.723
SC 4: This school provides staff with opportunities to actively participate in school decisions.	0.867
Instructional Practices	
IP 1: The importance of trying hard is really stressed to students.	0.716
IP 2: Students are told that making mistakes is OK as long as they are learning and improving.	0.653
IP 3: The emphasis is on really understanding schoolwork, not just memorizing it.	0.677
IP 5: It’s easy to tell which students get the highest grades and which students get the lowest grades.	0.773
IP 6: Students who get good grades are pointed out as an example to others.	0.724

The measurement items retained potentially represented the most empirically stable indicators of the constructs within the study context, but might not fully reflect all conceptual dimensions which were originally proposed in the scale development so in mitigating this concern, all the retained measurement items were carefully looked into to ensure alignment with the theoretical definitions of the constructs while also ensuring that reliability together with validity indices were within the recommended level in literature, revealing that the shortened scales nonetheless provided a coherent measurement of the intended five constructs.

Descriptive statistics and normality assessment

The results of the analysis of the descriptive statistics are for all the study variables, namely mathematics anxiety (MA), mathematics self-efficacy (MSE), mathematics teaching self-efficacy (MTSE), school climate (SC) and instructional practices of mathematics teachers, as shown in Table 3.

According to Hair et al. (2021), assessing descriptive statistics prior to structural equation modelling helps in the detection of possible anomalies and confirms that the data is appropriate for multivariate analysis (Hair et al., 2022). From Table 3, the mean scores ranged from 3.560 to 4.519 on a five-point Likert scale, indicating generally high levels of agreement across all constructs. Specifically, Mathematics Self-Efficacy items recorded means between 3.625 (MSE2) and 4.151 (MSE8). The results from the table reveal that scores on the mathematics teaching self-efficacy items ranged from 3.727 (MTSE2) to 4.077(MTSE6). The instructional practices items recorded mean values ranging from 3.560 for IP1 to 3.993 for IP6, while school climate items ranged from 3.950 (SC4) to 4.090 (SC2). Also, mathematics anxiety items revealed the highest means, ranging from 4.228 (MA4) to 4.519 (MA1), indicating elevated levels of mathematics anxiety among respondents.

Table 3. Descriptive statistics and normality assessment.

Name	Mean	Median	Min	Max	Std Dev.	Excess kurtosis	Skewness	Cramér-von Mises p value
MSE2	3.625	4.000	1.000	5.000	1.043	-0.098	-0.617	0.000
MSE4	3.725	4.000	1.000	5.000	1.069	0.092	-0.790	0.000
MSE7	3.914	4.000	1.000	5.000	1.111	0.385	-1.009	0.000
MSE8	4.151	4.000	1.000	5.000	1.044	1.042	-1.249	0.000
MTSE2	3.727	4.000	1.000	5.000	1.110	-0.331	-0.647	0.000
MTSE6	4.077	4.000	1.000	5.000	1.099	0.732	-1.186	0.000
MTSE7	3.767	4.000	1.000	5.000	1.117	0.235	-0.876	0.000
IP1	3.560	4.000	1.000	5.000	1.153	-0.230	-0.660	0.000
IP2	3.702	4.000	1.000	5.000	1.080	0.088	-0.756	0.000
IP3	3.788	4.000	1.000	5.000	1.075	0.059	-0.762	0.000
IP5	3.950	4.000	1.000	5.000	1.119	0.207	-0.959	0.000
IP6	3.993	4.000	1.000	5.000	0.979	0.598	-0.927	0.000
SC2	4.090	4.000	1.000	5.000	0.490	5.286	-0.484	0.000
SC3	3.993	4.000	1.000	5.000	0.580	1.905	-0.418	0.000
SC4	3.950	4.000	1.000	5.000	0.628	0.674	-0.236	0.000
MA1	4.519	5.000	1.000	5.000	0.500	-2.003	-0.077	0.000
MA3	4.300	4.000	1.000	5.000	0.458	-1.241	0.875	0.000
MA4	4.228	4.000	1.000	5.000	0.420	-0.308	1.301	0.000
MA5	4.517	5.000	1.000	5.000	0.500	-2.004	-0.068	0.000

The median for nearly all items was 4.000, while MA1 and MA5 recorded medians of 5.000, confirming that responses were concentrated toward the upper end of the response scale. Across all items, the maximum and minimum values spanned from 1.00 to 5.00, revealing that participants made use of the entire Likert scale. The pattern of responses crowding around the agreement option is typical in attitude studies that use a Likert scale questionnaire (Likert, 1932). The values of the standard deviations varied between 0.420 (MA4) and 1.153 (IP1), indicating an overall moderate level of variability. Lower variability was noted for school climate and mathematics anxiety measurement items, reflecting agreement among participants.

Examining the distributional properties showed that skewness values ranged from −1.249 (MSE8) to 1.301 (MA4). Excess kurtosis values ranged from −2.004 (MA5) to 5.286 (SC2). According to West et al. (1995), skewness within ±2 and kurtosis within ±7 are generally considered acceptable for multivariate analysis, while in the opinion of Kline (2016), skewness values greater than 3 and kurtosis above 10 indicate serious non-normality. Although the

Cramer-von Mises test detected statistically significant deviations, the data still fall within the acceptable thresholds, meaning that these differences are not substantial in practical terms and may be due to test sensitivity to sample size (Ghasemi and Zahediasl, 2012). In addition, data derived from Likert scales are ordinal by nature and seldom conform to the requirements of a normal distribution (Jamieson, 2004; Norman, 2010). The notable absence of perfect normality does not contradict the assumptions of PLS-SEM. In contrast to covariance-based SEM that assumes multivariate normality for maximum likelihood estimation, PLS-SEM adopts a variance-based framework utilizing ordinary least squares and is free from strict distributional assumptions (Hair et al., 2019; Hair et al., 2022). Rather than relying on normal-theory tests, PLS-SEM uses nonparametric bootstrapping to estimate standard errors and confidence intervals, making it resilient to non-normal data distributions, (Henseler et al., 2015). PLS-SEM remains the most suitable methodological tool for this study since the study employs a five-point Likert scale, and the skewness and kurtosis values fall within acceptable limits. Thus, the detected non-normality does not compromise the validity of the model estimation, and the data meet the essential assumptions for applying PLS-SEM.

Assessment of measurement model reliability and validity

In the context of PLS-SEM, assessing the measurement model is an essential step to confirm that latent constructs are reliably and validly measured before examining the structural paths. Internal consistency reliability is commonly evaluated using Cronbach's alpha and composite reliability (CR), with values of 0.70 or higher considered acceptable (Hair et al., 2022). In PLS-SEM, CR is often preferred because it provides a more accurate estimate of reliability compared to Cronbach's alpha (Hair et al., 2019).

Convergent validity is evaluated using the average variance extracted (AVE), where a value of at least 0.50 indicates that the construct explains more than half of the variance in its indicators (Fornell and Larcker, 1981). Finally, discriminant validity is assessed to ensure that constructs are empirically distinct from each other, commonly using the Fornell–Larcker criterion and the heterotrait–monotrait (HTMT) ratio of correlations, with HTMT values below 0.85 or 0.90 indicating adequate discriminant validity (Henseler et al., 2015; Hair et al., 2022). In this study, the HTMT ratio is adopted.

Table 4. Construct reliability and validity.

Construct	Cronbach alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average extracted variance (AVE)
IP	0.753	0.757	0.835	0.504
MA	0.818	0.824	0.877	0.642
MSE	0.687	0.704	0.806	0.511
MTSE	0.723	0.724	0.844	0.643
SC	0.761	0.800	0.861	0.675

As shown in Table 4, all the constructs meet acceptable standards of reliability and validity. The assessment of internal consistency reliability via Cronbach alpha reveals that all constructs achieve the acceptable cutoff of 0.70 apart from MSE, which is slightly below at 0.687 but is still acceptable in exploratory research contexts (Hair et al., 2019). In a similar vein, Dijkstra-Henseler's reliability coefficient and composite reliability (rho_a and rho_c), for all the constructs, exceed the 0.70 threshold, indicating adequate internal consistency. For convergent validity, all constructs meet the acceptable level required in the literature, with average variance extracted exceeding 0.5. In particular, IP (0.504), MA (0.642), MSE (0.511), MTSE (0.643), and SC (0.675) confirm that each construct accounts for over 50% of the variation in its indicators. All in all, the measurement model reflects adequate reliability and convergent validity, implying that the constructs are suitable for subsequent structural analysis.

Table 5 reveals that most inter-constructs correlations are within acceptable level limits, supporting the presence of sufficient discriminant validity among the constructs. Nevertheless, higher correlations are evident among some constructs, notably between MA and SC (0.831) and between IP and MSE (0.816), implying a strong linkage between the constructs. Notwithstanding these elevated values, the general pattern supports sufficient discriminant validity, with most correlations remaining within an acceptable level in the literature (values less than 0.90), indicating that the constructs are distinct enough for subsequent structural analysis.

Table 5. Discriminant validity.

Construct	IP	MA	MSE	MTES	SC	SC x MA	SC x MSE
IP							
MA	0.155						
MSE	0.816	0.147					
MTSE	0.766	0.164	0.554				
SC	0.247	0.831	0.169	0.202			
SC x MA	0.160	0.544	0.075	0.116	0.821		
SC x MSE	0.125	0.100	0.218	0.112	0.187	0.212	

Table 6. Direct effects.

Path	Original sample (O)	Sample mean (M)	Standard deviation	T Statistics (|O/STDEV|)	P values
MA -> IP	-0.057	-0.043	0.047	1.201	0.230
MSE -> IP	0.441	0.445	0.042	10.449	0.000
MSE -> MTSE	0.384	0.386	0.047	8.205	0.000
MTSE -> IP	0.380	0.378	0.052	7.311	0.000
SC -> MTSE	0.109	0.111	0.041	2.676	0.007

The outcomes of the structural model, as indicated in Table 6, suggest several of the proposed relationships are significant. In particular, mathematics self-efficacy (MSE) has a significant positive effect on instructional practices, IP ($\beta = 0.441$, $t = 10.449$, $p < 0.001$), implying that an increase in mathematics self-efficacy tends to also increase the levels of instructional practices. Similarly, mathematics self-efficacy significantly influences mathematics teaching self-efficacy ($\beta = 0.384$, $t = 8.205$, $p < 0.001$), and mathematics teaching self-efficacy also has a significant positive effect on instructional practices ($\beta = 0.380$, $t = 7.311$, $p < 0.001$). In addition, school climate (SC) significantly affects mathematics teaching self-efficacy($\beta = 0.109$, $t = 2.676$, $p = 0.007$), indicating a positive but relatively weaker relationship. In contrast, some relationships are not statistically significant. Mathematics anxiety (MA) does not significantly influence instructional practices ($\beta = -0.057$, $p = 0.230$). Generally, the analysis suggests that mathematics self-efficacy and mathematics teaching self-efficacy emerge as the most influential determinants of instructional practices.

Moderation effects of school climate

Moderation occurs when the relationship between two variables changes in strength or direction based on the level of another variable. In this study, school climate (SC) was assessed as a potential moderator of the relationships between mathematics anxiety (MA) and instructional practices (IP), mathematics self-efficacy and instructional practices, and mathematics self-efficacy and mathematics teaching self-efficacy.

Table 7. Moderation effect school climate.

Path	Original Sample (O)	Sample mean (M)	Standard deviation	T Statistics (|O/STDEV|)	P values
SC x MA -> IP	0.027	0.022	0.054	0.500	0.617
SC x MSE -> IP	-0.005	-0.005	0.040	0.124	0.901
SC x MSE -> MTSE	-0.049	-0.049	0.048	1.015	0.310

The findings from the moderation analysis are shown in Table 7 and Figure 2. The outcomes of the analysis reveal that not all the moderation effects are statistically significant. Notably, the interaction between school climate (SC) and mathematics anxiety (MA) on instructional practices (IP) is not significant ($\beta = 0.027$, $t = 0.500$, $p = 0.617$), implying that school climate does not significantly moderate this relationship. Similarly, the interaction between school climate and mathematics self-efficacy (MSE) on instructional practices is not significant (β = -0.005, t = 0.124, p = 0.901), indicating that school climate does not significantly alter the effect of mathematics self-efficacy on instructional practices. In addition, the moderating effect of school climate on the relationship between mathematics self-efficacy and mathematics teaching self-efficacy is also not significant (β = -0.049, t = 1.015, p = 0.310). Although the interaction coefficients show both positive (SC × MA → IP) and negative (SC × MSE → IP and SC × MSE → MTSE) signs—indicating a possible slight enhancing and mitigating tendency respectively, these effects are not statistically significant. Hence, there is no evidence that school climate strengthens or weakens any of the relationships in the model. In totality, the findings indicate that school climate does not play a significant moderating role in the structural relationships.

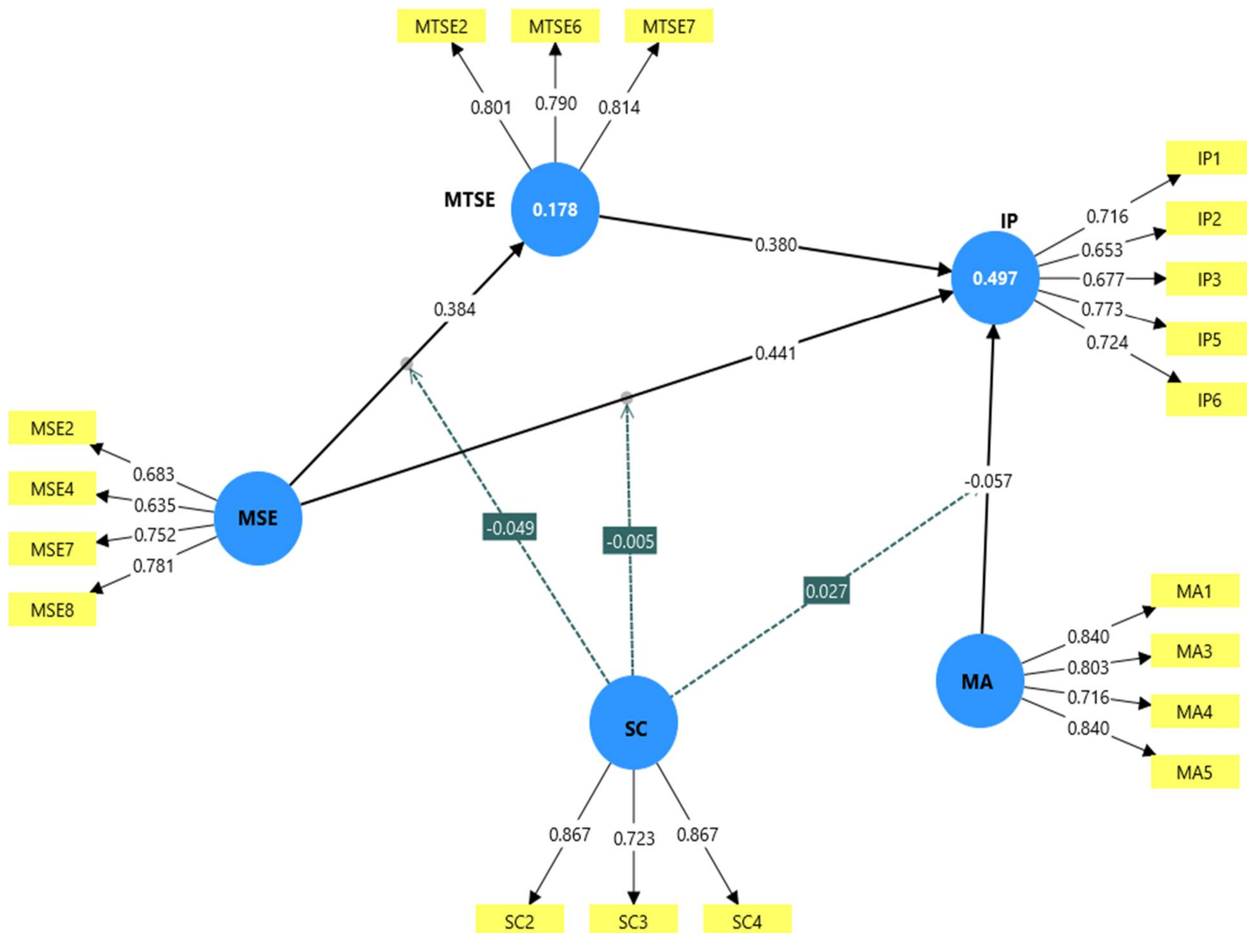

Figure 2. Structural model indicating SC as a moderator.

Effect size (f²)

The effect size (f²) findings show the extent to which each exogenous construct contributes to the endogenous variables in the structural model. Based on Cohen's (1988) benchmarks, effect sizes of 0.02, 0.15 and 0.35 correspond to small, moderate and large effects.

From Table 8, the findings reveal that mathematics self-efficacy has a medium-to-large effect on instructional practices (f^2 = 0.310), indicating it is the most influential predictor of instructional practices in the model. Similarly, mathematics teaching self-efficacy has a medium effect on instructional practices (f^2 = 0.236), suggesting a meaningful contribution to explaining instructional practices. In addition, mathematics self-efficacy has a small-to-moderate effect on mathematics teaching self-efficacy ($f^2 = 0.169$), indicating its relevance in predicting mathematics teaching self-efficacy. In contrast, all remaining effects, including mathematics anxiety, school climate, and the interaction terms (SC × MA and SC × MSE), show very small or negligible effect sizes ($f^2 < 0.02$). This suggests that these variables contribute minimally to the explanatory power of the endogenous constructs.

Table 8. F-square.

	IP	MA	MSE	MTSE	SC	SC x MA	SC x MSE
IP							
MA	0.003						
MSE	0.310			0.169			
MTSE	0.236						
SC	0.003			0.014			
SC × MA	0.001						
SC × MSE	0.000			0.002			

DISCUSSION

The present study shows that mathematics self-efficacy (MSE) is a strong and significant predictor of instructional practices (IP), revealing that teachers' confidence in their mathematical competence is translated into the quality of their classroom lesson delivery. This finding implies that instructional practice is not the sole determinant of teachers' content knowledge, but also their belief in their capability to make use of that knowledge effectively during instruction. Teachers with high mathematics self-efficacy are most likely to approach lesson planning, classroom interactions, and instructional decision-making with greater confidence, persistence, and flexibility. Such teachers are potentially employed to use learner-centred strategies, adapt instruction to meet diverse learning needs, and remain committed when students experience learning difficulties. As a result, mathematics self-efficacy serves as a critical psychological resource that enables mathematics teachers to modify mathematical knowledge into effective classroom practice.

This finding is well explained by Bandura's Social Cognitive Theory, which suggests that self-efficacy affects individual teachers' choices, effort, perseverance, and resilience in the performance of challenging tasks. Teachers who believe in their mathematical capability are therefore more likely to view instructional challenges as manageable rather than threatening, leading them to put into practice more effective instructional strategies in the classroom. This interpretation is supported by recent evidence identifying teacher self-efficacy as a critical determinant of instructional quality, classroom effectiveness, and student achievement (Zee and Koomen, 2024; Duan et al., 2024; Hendricks et al., 2024; Zakariya and Adegoke, 2024).

The study further revealed that mathematics self-efficacy significantly predicts mathematics teaching self-efficacy, suggesting that confidence in one's mathematical competence forms the psychological basis for confidence in teaching mathematics. This relationship implies that teachers acquire confidence in their own understanding of mathematics before becoming confident in their ability to facilitate students' learning. In other words, pedagogical confidence appears to emerge from perceived mastery of subject content. Teachers who believe they possess sufficient mathematical knowledge are more likely to explain concepts with clarity, respond confidently to students' questions, and make use of diverse instructional strategies without fear of making errors. The finding, therefore, highlights the interconnected nature of content competence and pedagogical competence, suggesting that strengthening teachers' confidence in mathematics may simultaneously improve their confidence in mathematics instruction. This interpretation is consistent with previous studies reporting that subject-specific competence serves as a precursor to teaching self-efficacy (Hendricks et al., 2024; Swars et al., 2023).

In contrast, mathematics anxiety did not have a significant direct influence on instructional practices. This finding suggests that although teachers may experience feelings of anxiety in relation to mathematics, such emotions do not necessarily translate into ineffective classroom instruction. One possible explanation is that experienced teachers develop coping mechanisms that enable them to control their emotions and maintain professional standards despite experiencing anxiety. Classroom teaching often requires teachers to draw upon established routines, accumulated teaching experience, and professional responsibility, which may lessen the behavioural consequences of mathematics anxiety. It is therefore possible that anxiety influences teachers' internal emotional experiences without substantially affecting their observable instructional behaviours. Another plausible explanation is that the positive influence of mathematics self-efficacy may offset the negative effects of anxiety. Teachers who possess strong confidence in their mathematical abilities may be better equipped to manage feelings of anxiety, thereby preventing these emotions from interfering with instructional delivery. This interpretation aligns with emerging evidence suggesting that mathematics anxiety influences teaching outcomes indirectly through self-efficacy and emotional regulation rather than through a direct pathway (Zee and Koomen, 2024; Morales-Navarro et al., 2023).

With regard to the moderating effect, the finding that school climate did not significantly moderate the relationship between teachers' psychological characteristics and instructional practices suggests that internal beliefs may exert a more dominant influence on teaching behaviour than contextual conditions. Although supportive school environments provide important organisational resources, they may not fundamentally alter the extent to which teachers translate their beliefs into instructional practice. Teachers with strong mathematics self-efficacy appear capable of maintaining effective instructional behaviours regardless of variations in the school environment, indicating that self-efficacy functions as a relatively stable personal resource. Conversely, teachers with lower levels of self-efficacy may not automatically improve their instructional practices simply because they work in a positive school climate. This finding implies that improvements in instructional practice may depend more on strengthening teachers' internal beliefs than on modifying contextual conditions alone. Consequently, interventions designed to improve mathematics instruction should complement efforts to create supportive school environments with programmes that explicitly develop teachers' confidence in both mathematics content and mathematics teaching. This interpretation is consistent with recent evidence suggesting that teacher self-efficacy remains a robust predictor of instructional effectiveness across diverse educational contexts (Zee and Koomen, 2024; Duan et al., 2024).

Conclusion

In conclusion, the study reveals that both mathematics self-efficacy and teaching self-efficacy are predictors of instructional practices of mathematics teachers, while mathematics anxiety has no impact on instructional practices. The study reveals that school climate does not strengthen or weaken the relationships between mathematics self-efficacy and instructional practices, mathematics teaching self-efficacy and instructional practices, and the relationship between mathematics anxiety and instructional practices.

RECOMMENDATIONS

The findings of this study have important implications for teacher education, professional development, and school leadership. Since Mathematics Self-Efficacy (MSE) and Mathematics Teaching Self-Efficacy (MTSE) significantly influence instructional practices, teacher education programmes should prioritize interventions that strengthen teachers' confidence in both their mathematical competence and instructional abilities. This can be achieved through mastery-oriented experiences such as microteaching, lesson demonstrations, guided classroom practice, mentoring, and constructive feedback, consistent with Bandura's Social Cognitive Theory.

Although mathematics anxiety did not significantly affect instructional practices, efforts to support teachers should extend beyond anxiety reduction to include strategies that build self-efficacy. Strengthening teachers' confidence is likely to have a more direct impact on improving instructional quality while also helping them manage anxiety effectively.

Furthermore, the non-significant moderating effect of school climate suggests that creating a positive school environment alone may not be sufficient to improve instructional practices. Therefore, school improvement initiatives should combine supportive organisational conditions with targeted professional development that enhances teachers' self-efficacy. By integrating capacity-building programmes with positive school leadership and collaboration, educational institutions can create conditions that promote more effective mathematics instruction.

REFERENCES

Bandura, A. (2001). Toward a psychology of human agency: Pathways and reflections. *Perspectives on Psychological Science, 15*(6), 1304–1316.

Burić, I., & Kim, L. E. (2020). Teacher self-efficacy, instructional quality, and student outcomes: A longitudinal study. *Learning and Instruction, 66*, 101302. https://doi.org/10.1016/j.learninstruc.2019.101302

Cohen, J., McCabe, L., Michelli, N. M., & Pickeral, T. (2023). School climate: Research, policy, and practice revisited. *Teachers College Record, 125*(1), 180–213.

Collie, R. J., Shapka, J. D., & Perry, N. E. (2020). School climate and teacher well-being: The mediating role of teachers' self-efficacy. *Teaching and Teacher Education, 89*, 103015.

Duan, S., Bissaker, K., & Xu, Z. (2024). Correlates of teachers' classroom management self-efficacy: A systematic review and meta-analysis. *Educational Psychology Review, 36*, 43.

Foley, A. E., Herts, J. B., Borgonovi, F., Guerriero, S., Levine, S. C., & Beilock, S. L. (2019). The math anxiety-performance link: A global phenomenon. *Current Directions in Psychological Science, 28*(1), 52–58.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50.

Ghasemi, A., & Zahediasl, S. (2012). Normality tests for statistical analysis: A guide for non-statisticians. *International Journal of Endocrinology and Metabolism, 10*(2), 486–489. https://doi.org/10.5812/ijem.3505

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2019). *A primer on partial least squares structural equation modeling (PLS-SEM)* (2nd ed.). Sage.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2021). Partial least squares structural equation modeling: Rigorous applications, better results, and higher acceptance. *Long Range Planning, 54*(1), 101961.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.). Sage.

Hendricks, W., Olawale, B. E., & Saddiq, K. (2024). Preservice teachers' self-efficacy in teaching mathematics. *Education Sciences, 14*(11), 1262.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based SEM. *Journal of the Academy of Marketing Science, 43*(1), 115–135.

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). Guilford Press.

Klusmann, U., Kunter, M., Trautwein, U., Lüdtke, O., & Baumert, J. (2021). Teachers' professional competence and instructional quality: The role of self-efficacy. *Journal of Educational Psychology, 113*(4), 780–798. https://doi.org/10.1037/edu0000475

Lazarides, R., Buchholz, J., & Rubach, C. (2020). Teacher enthusiasm and self-efficacy: Their impact on instructional practices in mathematics. *Teaching and Teacher Education, 90*, 103044. https://doi.org/10.1016/j.tate.2020.103044

Midgley, C., Maehr, M. L., Hruda, L. Z., Anderman, E., Anderman, L., Freeman, K. E., & Urdan, T. (2000). *Manual for the patterns of adaptive learning scales*. Ann Arbor: University of Michigan, 734.

Morales-Navarro, L., Giang, M. T., Fields, D. A., & Kafai, Y. B. (2023). Connecting beliefs, mindsets, anxiety, and self-efficacy in learning contexts. *arXiv preprint arXiv:2307.10010*.

OECD (2023). *PISA 2022 results (Volume I): The state of learning and equity in education*. OECD Publishing. https://doi.org/10.1787/53f23881-en

Pekrun, R., Lichtenfeld, S., Marsh, H. W., Murayama, K., & Goetz, T. (2019). Achievement emotions and academic performance: Longitudinal models of reciprocal effects. *Child Development, 90*(5), 1653–1670. https://doi.org/10.1111/cdev.13165

Pyper, J. R., Freiberg, H. J., Ginsburg, M., & Spuck, D. W. (1987). *School climate questionnaires: Instruments to measure teacher, parent, and student perceptions of school climate*. In H. J. Freiberg (Ed.), School climate (PDK Hot Topics Series, pp. 87–96). Phi Delta Kappa Educational Foundation.

Skaalvik, E. M., & Skaalvik, S. (2020). Teacher self-efficacy and teacher burnout: A study of relations. *Teaching and Teacher Education, 96*, 103179. https://doi.org/10.1016/j.tate.2020.103179

Swars, S. L., Daane, C. J., & Giesen, J. (2023). Mathematics anxiety and teacher efficacy in preservice teachers: Updated perspectives. *School Science and Mathematics, 123*(2), 85–97.

Wang, M. T., & Degol, J. L. (2020). School climate: A review of the construct, measurement, and impact on student outcomes. *Educational Psychology Review, 32*(3), 543–575.

Zakariya, Y. F., & Adegoke, N. A. (2024). Teacher instructional practices and self-efficacy relations. *Frontiers in Education, 9*, 1367076.

Citation: Aabeyir, B., Bonyah, E., and Larbi, E. (2026). Exploring the relationship among mathematics self-efficacy, mathematics teaching self-efficacy, mathematics anxiety and instructional practices: Moderating role of school climate. *African Educational Research Journal, 14*(3), 514-527.