Journal of Social, Humanity, and Education (JSHE)
ISSN 2746-623X, Vol 6, No 4, 2026, 407-427 https://doi.org/10.35912/jshe.v6.n4.p407-427.2026

Mediating Effect of Students' Motivation Between the Relationship of Classroom Environment and Mathematics Problem-Solving Skills

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Article History
Received on 28 March 2026
1st Revised on 31 March 2026
2nd Revised on 6 May 2026
3rd Revised 7 May 2026
Accepted on 18 May 2026

Abstract

Purpose: The main purpose of This study aimed to investigate the mediating effect of students' motivation on the relationship between classroom environment and mathematics problem-solving skills among first-year Bachelor of Secondary Education major in Mathematics students at Davao del Norte State College.

Research Methodology: Using a quantitative descriptive-correlational research design, data were collected from 79 randomly selected students through standardized questionnaires.

Results: The study found significant positive correlations between classroom environment and students' motivation, classroom environment and mathematics problem-solving skills, and students' motivation and mathematics problem-solving skills. Regression analysis further confirmed that the classroom environment significantly influenced both students' motivation and mathematics problem-solving skills, while students' motivation also significantly influenced their mathematics problem-solving skills. However, the indirect effect of the classroom environment on mathematics problem-solving skills through students' motivation was not statistically significant, indicating that students' motivation does not mediate this relationship. This suggests that while motivation is an important factor, it does not serve as the mechanism through which the classroom environment affects problem-solving skills.

Conclusions: Students' motivation does not mediate the relationship between classroom environment and mathematics problem-solving skills.

Limitations: The sample was limited to first-year mathematics students from a single institution, which restricted the generalizability of the findings to other contexts.

Contributions: This study aims to generate insights that can strengthen students' preparedness for mathematical challenges in higher education.

Keywords: *Classroom Environment, Mediation Effect, Mathematics Problem-Solving Skills, Students' Motivation, Quantitative Research*

How to Cite: Soriamo, A. R. A., Truya, S. R. C., Epe, N. J. T., Richa, B. J. E., & Sadji, A. E. (2026). Mediating Effect of Students' Motivation Between the Relationship of Classroom Environment and Mathematics Problem-Solving Skills. *Journal of Social, Humanity, and Education,* 6(4), 407-427.

1. Introduction

Problem-solving skills are considered a fundamental component of mathematics education and should be prioritized in any mathematics program (Olivares, Lupiáñez, & Segovia, 2021). Despite this, studies show that students consistently struggle with mathematical problem-solving tasks (Chirimbana, Nghipandulwa, & Kamati, 2022; Vidad & Quimbo, 2021). Similar concerns have been reported in international studies. Prospective mathematics teachers from a state university in Turkey exhibited deficiencies in understanding problems, identifying appropriate solution strategies, applying techniques accurately, and evaluating solutions (Güner & Erbay, 2021).

In the Philippines, particularly in Cagayan, students demonstrate strong mathematical problem-solving skills but often make errors in problem formulation. There is still a need to improve reading comprehension, conceptual understanding, and reasoning skills (Norveen S Campanilla & Mendoza, 2024). In the Davao Region, Velez et al. (2023) identified common difficulties such as analyzing problems, understanding mathematical concepts, identifying correct answers, formulating equations, and simplifying expressions that hinder effective problem-solving. Elaiza, Superioridad, and Tado (2024) assessed students in the Kapalong District, Davao del Norte, across four problem-solving steps. Results showed average proficiency, with the highest scores in "Devise a plan" (61.36), followed by "Understand the problem" (59.67). However, lower scores in "Carry out the plan" (54.32) and "Look back" (48.86) indicate challenges in executing and evaluating solutions.

Several studies have examined the influence of the classroom environment on mathematics performance, including problem-solving skills (Byiringiro, 2024; Liu et al., 2022; Sydänmaanlakka, Häsä, Holm, & Hannula, 2024). However, the mediating role of student motivation in the relationship between classroom environment and mathematics problem-solving skills remains underexplored, particularly among Bachelor of Secondary Education students majoring in Mathematics. Local studies addressing these relationships in the Philippine context are limited. Given these gaps, this study examines the mediating effect of student motivation on the relationship between the classroom environment and mathematics problem-solving skills among tertiary students in Panabo City, Davao del Norte, Philippines. This study aims to provide insights that can strengthen students' preparedness for mathematical challenges in higher education.

2. Literature Review and Hypotheses Development

2.1 Mathematics Problem-Solving Skills

Problem-solving is widely recognized as a multi-stage process involving various strategies (Sangwan & Singh, 2022). Incorporating real-life problems into learning helps students develop skills in solving challenges, particularly in mathematics, which they commonly encounter in daily life (Harini, Islamia, Kusumaningrum, & Kuncoro, 2023). Guo, Xu, and Chen (2023) found that a positive classroom atmosphere, including teacher-student relationships and task focus, significantly influences academic success in Chinese university students learning English as a Foreign Language. Similarly, Mehrun-Nisa and Rauf (2025) highlighted the impact of student-teacher relationships on academic involvement in Problem-Based Learning (PBL) environments. Collaborative Ness does not only involve interpersonal skills but also a shared commitment to collective problem-solving and knowledge creation (Xu, Wang, & Wang, 2023). Order and Student Involvement are essential for engagement and discipline. Clear expectations and addressing disruptions improve student behavior (Khuntia & Sahoo, 2025). Classroom management should maintain control while promoting respect, collaboration and engagement (Ye, 2024). Student engagement, that is, students' involvement in their own learning activities, is influenced by both individual and classroom factors.

2.2 Teacher Involvement

Teacher involvement is the active engagement of teachers in their students' academic and emotional development, fostering an effective educational experience (Boruah, Phogat, & Singh, 2024). It promotes students' overall development through strong teacher-student relationships, goal-setting support, and guidance for personal and academic growth (Huot, Hok, Kumar, & Heng, 2024). Teacher support refers to positive and supportive teacher-student relationships, which are important in helping

students overcome learning challenges, encouraging meaningful course involvement, and maintaining academic success (Huang & Wang, 2023).

2.3 Students' Motivation

Motivation plays a crucial role in students' academic achievements and engagement. Wu (2019) found that strong motivation positively influences both academic engagement and achievement. It is also an essential prerequisite for completing learning activities and serves as the driving force in the learning process (Delos Santos et al., 2026).

2.4 Intrinsic and Extrinsic Goal Orientation

Students with a strong Intrinsic Goal Orientation are more likely to actively participate in their learning experiences, which enhances their overall educational journey (Setyoadi & Patmanthara, 2024). Research indicates that students with strong Extrinsic Goal Orientation often prioritize performance over mastery, leading to surface-level engagement with learning materials (Frumos et al., 2024). This focus on external validation may enhance short-term performance but can reduce deeper learning experiences for students. A high intrinsic value in a subject increase's persistence and success chances. Task value influences students' engagement with learning activities and academic performance (Linnenbrink-Garcia & Wormington, 2019).

2.5 Learning Beliefs

Learning beliefs are students' views about their preferred ways of learning, including the meaning of learning and the roles of teachers and students**.** Lai (2019) found that learner beliefs influence engagement in autonomous out-of-class technology use and how learners select and interact with technological resources. Self-efficacy refers to an individual's confidence in their capacity to complete a task or achieve an objective. High self-efficacy promotes resilience and persistence despite setbacks, whereas low self-efficacy may lead to disengagement or avoidance (Alrashidi & Alshammari, 2025). According to Noveen S Campanilla (2025), it has been suggested that students' self-efficacy is related to their performance in various academic areas, including mathematics.

2.6 Classroom Environment and Students' Motivation

Teachers who establish interesting and supportive learning environments help students develop self-efficacy, or the belief that they can succeed (Schunk & Mullen, 2012). The studies of Cayubit (2022) and Elfira, Violita, and Santosa (2022) supported the assertion that classroom environment and students' motivation has a relationship and are positively correlated. Problem-solving skills can be developed through intrinsic and extrinsic motivation (Urhahne, 2021). Harahap (2021) further noted that students' ability to solve mathematical problems improves as their level of learning motivation increases. Beyond cognitive aspects, emotional factors, such as self-efficacy, influence students' persistence in problem-solving. Students with higher self-efficacy are more likely to persist in difficult tasks, whereas those with lower confidence tend to avoid them, limiting their engagement in problem-solving processes (Alrashidi & Alshammari, 2025).

Furthermore, social factors, such as peer interaction and classroom support, enhance students' motivation and engagement in problem-solving activities. A supportive learning environment promotes collaboration and idea sharing, thereby improving students' understanding and problem-solving skills (Schunk & Mullen, 2012; Ye, 2024). Overall, these findings highlight that motivation interacts with social and emotional factors in shaping students' engagement and performance in mathematical problem-solving.

2.7 Classroom Environment and Problem-Solving Skills

Creating an inclusive and supportive atmosphere encourages students to engage in risk-taking and explore various solutions, boosting their confidence and resilience in tackling mathematical challenges (Yilmaz-Can, Baber-Elbistan, Pekgöz, & Sensin, 2023). Similarly, students' perceptions of their learning environment are significantly associated with academic achievement, suggesting that a positive classroom environment improves learning outcomes and supports the development of higher-order skills such as problem-solving (Masud, Mensah, Subarna, & Hasan, 2023).

2.8 Hypotheses

The following hypotheses were formulated:

- H_1: The classroom environment has no significant direct effect on mathematics problem-solving skills among first-year BSED Mathematics students
- H_2: The classroom environment has no significant direct effect on students' motivation among first-year BSED Mathematics students
- H_3: Students' motivation has no significant direct effect on mathematics problem-solving skills among first-year BSED Mathematics students
- H_4: The classroom environment and students' motivation do not have a significant combined effect on mathematics problem-solving skills among first-year BSED Mathematics students
- H_5: Students' motivation does not have a significant indirect effect on the relationship between the classroom environment and mathematics problem-solving skills among first-year BSD Mathematics students

3. Methodology

3.1 Research Design

The researchers utilized a quantitative approach and a descriptive-correlational research design to examine the potential relationship between the classroom environment and mathematics problem-solving skills through students' motivation. Quantitative research involves the collection and analysis of numerical data to identify patterns, compute averages, test relationships, generate predictions and generalize results (Apuke, 2017). Siedlecki (2020) noted that descriptive research designs seek to illustrate the characteristics of a population or phenomenon without manipulating variables.

The correlational design determines the relationships among variables by examining the strength and direction of their associations without inferring causality (Devi, Lepcha, & Basnet, 2022). To determine whether students' motivation mediates the relationship between classroom environment and mathematics problem-solving skills, a regression-based mediation analysis was conducted. The classroom environment served as the independent variable (X), students' motivation as the mediating variable (M), and mathematics problem-solving skills as the dependent variable (Y). The mediation model is shown in Figure 2.

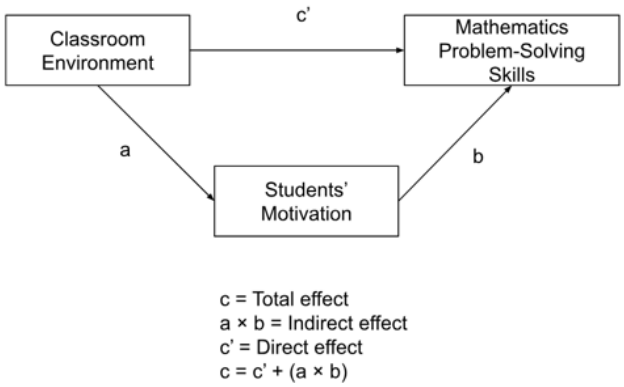

Figure 2. Mediation model

The mediating effect was tested using Hayes' PROCESS Macro version 4.1 (Model 4) in the IBM SPSS. The indirect effect (a × b) of the classroom environment on problem-solving skills through students' motivation was estimated using 5,000 bootstrap resamples to generate bias-corrected 95% confidence intervals (González-Romá et al., 2023). Mediation was considered significant when the confidence interval for the indirect effect did not include zero (Pesigan & Cheung, 2024). Bootstrapping was employed to obtain more accurate estimates of indirect effects and to address potential non-normality in the sampling distribution (Hayes, 2017; MacKinnon, Lockwood, & Williams, 2004). All analyses were conducted at a significance level of 0.05.

3.2 Research Respondents

The respondents of this study were first-year Bachelor of Secondary Education (BSED) major in Mathematics students enrolled at Davao del Norte State College, Panabo City, during the Academic Year 2024-2025. These students were selected because they were taking mathematics courses that required the application of mathematical problem-solving skills. Simple random sampling was used to select respondents from the total population of first-year BSED Mathematics students. This technique ensured that each student had an equal probability of being included, minimizing sampling bias and enhancing the sample representativeness (Noor, Tajik, & Golzar, 2022). Only students officially enrolled during the semester and who consented voluntarily were included in this study.

3.3 Research Instruments

In this study, the researchers utilized three questionnaires to collect data on whether students' motivation mediates the relationship between the classroom environment and mathematics problem-solving skills. The questionnaires measuring classroom environments and students' motivation were validated by experts to ensure their reliability and content validity. A standardized questionnaire was used to assess students' mathematics problem-solving skills. The Classroom Environment Questionnaire (CEQ) was adopted from John, Frances, and Hin-wah (2003), which assess students' perceptions of their learning environment.

It measures key dimensions relevant to mathematics learning, including collaborative Ness, order, student involvement, teacher involvement, and teacher support. The items were contextualized to reflect the experiences of first-year BSED Mathematics students in the study. A five-point Likert scale was used to measure responses, such as 5 (Always), 4 (Often), 3 (Sometimes), 2 (Rarely), and 1 (Never). Mean scores were computed to determine the level of classroom environment. The instrument demonstrated excellent reliability during pilot testing, with a Cronbach's alpha of 0.930. The following parameters and descriptions were used to evaluate the extent of the classroom environment, as can be seen in Table 1.

Table 1. Interpretation of classroom environment mean scores

Parameter Limits	Descriptive Equivalent	Interpretation
4.20 – 5.00	Always	This means that a conducive classroom environment is observed at all times.
3.40 – 4.19	Often	This means that a conducive classroom environment is frequently observed.
2.60 – 3.39	Sometimes	This means that conducive classroom environments are observed occasionally.
1.80 – 2.59	Rarely	This means that conducive classroom environments are infrequently observed.
1.00 – 1.79	Never	This means that a conducive classroom environment was not observed.

To measure the mediating variable, the Mathematical Motivation Scale (MMS), developed by Suren and Kandemir (2020), was adapted to determine students' level of motivation in learning mathematics. The instrument was selected because it assesses motivational factors such as intrinsic goal orientation, extrinsic goal orientation, task value, learning beliefs, and self-efficacy, capturing both internal and external influences on learning mathematics. Responses were measured using a five-point Likert scale: 5 (Strongly Agree), 4 (agree), 3 (Moderately Agree), 2 (disagree), and 1 (Strongly Disagree). Mean scores were used to determine the students' motivation levels. The instrument demonstrated excellent reliability during the pilot testing, with a Cronbach's alpha of 0.942. The following parameters and descriptions were applied to evaluate students' motivation, as can be seen in Table 2.

Table 2. Interpretation of student's motivation mean scores

Parameter Limits	Descriptive Equivalent	Interpretation
4.20 – 5.00	Very High	This means that the students' motivation was very high.
3.40 – 4.19	High	This means that the students' motivation was high.
2.60 – 3.39	Moderate	This means that the students' motivation is very moderate
1.80 – 2.59	Low	This indicates that the students' motivation was low.
1.00 – 1.79	Very Low	This means that the students' motivation was very low.

For the dependent variable, the researchers adopted the Problem-Solving Skills Questionnaire standardized by Siniguian (2017) to measure students' mathematics problem-solving skills, with Polya's problem-solving strategy as the conceptual basis for answering the word problems. A scoring rubric developed used to evaluate each sub-item. The test assessed four dimensions: (1) Understanding the Problem (0–3 points), (2) Devising a Plan (0–2 points), (3) Carrying Out the Plan (0–4 points), and (4) Looking Back (0–1 points). The instrument demonstrated excellent reliability, with a Cronbach's alpha of 0.917, indicating a reliable measurement. The following parameter limits, descriptive equivalents, and interpretations were used to evaluate the overall test score, as can be seen in Table 3.

Table 3. Interpretation of problem-solving skills scores

Parameter Limits	Descriptive Equivalent	Interpretation
41-50	Very High	This means that the students' problem-solving skills in mathematics are outstanding.
31-40	High	This means that the students' problem-solving skills in mathematics are above satisfactory.
21-30	Average	This means that the students' problem-solving skills in mathematics were satisfactory.
11-20	Low	This means that the problem-solving skills of the students in mathematics are below satisfactory.
1-10	Very Low	This means that the students' problem-solving skills in mathematics are above satisfactory.

4. Results and Discussions

4.1 Extent of Classroom Environment in terms of Collaborative Ness of Students

Table 4 highlights the level of collaboration. The highest mean score was 4.30 for "My classmates help each other in learning mathematics," followed by 4.29 for "If I do not understand the teacher's instruction in mathematics activities, I can ask my classmates," both categorized as "always." However, "After class, my classmates and I can find others to discuss mathematics homework with" received the lowest mean of 3.87, categorized as "often," indicating that this practice is observed frequently. The overall mean of 4.17 is interpreted as "often," indicating a high level of collaboration. The standard deviation was 0.58, suggesting similar perceptions among respondents regarding the classroom environment's level of collaborative Ness.

Table 4. Extent of classroom environment in terms of collaborative Ness of students

No	Items	Mean	SD	Descriptive Equivalence
1	My classmates help each other learn mathematics.	4.304	0.686	Always
2	After class, my classmates and I can find others to discuss Mathematics homework with.	3.886	0.920	Often
3	If I have a difficulty in learning mathematics, I can find classmates to ask for help.	4.228	0.816	Always

4	If I do not understand the teacher's instruction in mathematics activities, I can ask my classmates to help me.	4.291	0.770	Always
5	I like to share the learning materials in mathematics with other students.	4.114	0.716	Often
6	I can cooperate with other students to complete the learning task in mathematics.	4.177	0.747	Often
Category Mean		4.17	0.58	Often

This result indicates that first-year students consistently support each other in learning mathematics. When they struggle to understand instructions or encounter difficulties, they rely on classmates for help, collaborate on tasks, and share resources with their peers. This was supported by study, Lu and Smiles (2022) which found that recognizing the value of purposeful inquiry increases students' awareness of their roles in collaborative learning. It also enables them to support their own and others' inquiry processes while working toward learning goals. Additionally, collaborative learning can improve students' academic performance and self-evaluation (Chukwuka & Pius, 2024).

4.2 Extent of Classroom Environment in terms of Order and Student Involvement

Table 5 presents the level of the classroom environment in terms of order and student participation. The highest mean score was 4.03 for "When the teacher teaches mathematics, my classmates and I will normally behave ourselves," followed by 3.86 for "During the lessons, my classmates and I work hard to do their mathematics assignments," both interpreted as "often," indicating that these behaviors were observed frequently. However, "The classroom is very noisy during mathematics class" had the lowest mean score of 2.97, interpreted as "sometimes," indicating that this occurs occasionally. The overall mean of 3.55, interpreted as "often," suggests frequent positive observations. Meanwhile, the standard deviation of 0.61 indicates close agreement among students' perceptions of these aspects of the classroom environment.

Table 5. Extent of classroom environment in terms of order and student involvement

No	Items	Mean	SD	Descriptive Equivalence
1	In mathematics class, my classmates and I can keep quiet.	3.772	0.697	Often
2	During the lessons, my classmates and I work hard to do mathematics assignments.	3.861	0.711	Often
3	The classroom is very noisy during mathematics classes.	2.975	1.281	Sometimes
4	In mathematics class, my classmates and I are working very hard to study.	3.747	0.775	Often
5	When the teacher teaches mathematics, my classmates and I will normally behave myself.	4.025	0.784	Often
6	I am disturbed by my classmates in the mathematics class.	3.152	1.063	Sometimes
7	In mathematics class, some of my classmates speak loudly, Some read other books, and some talk with each other.	3.304	1.148	Sometimes
Category Mean		3.55	0.61	Often

This result indicates that first-year students often exhibit good behavior during mathematics lessons, remaining quiet and diligently working on assignments. However, speaking loudly, reading other books, and talking with each other sometimes occurred in the mathematics class. These results are consistent with Khuntia and Sahoo (2025), who found the importance of classroom management strategies, such as setting clear expectations and addressing disruptions early, in promoting positive behavior and increasing engagement.

4.3 Extent of Classroom Environment in terms of Teacher Involvement

Table 6 presents the level of classroom environment in terms of teacher involvement: The statement "My teacher is willing to answer students' questions about mathematical concepts" obtained the highest mean score of 4.08, followed by "Before mathematics class, my teacher has enough preparation" at 4.03, both interpreted as "often," indicating that these practices are observed frequently. The lowest mean score of 3.73 for "My teacher is earnest in teaching mathematics" is still interpreted as "often," indicating that this behavior is also observed frequently. The overall mean of 3.90, interpreted as "often," indicates frequent positive involvement of teachers. A standard deviation of 0.5 suggests agreement among students regarding their perceptions of teacher involvement.

Table 6. Extent of classroom environment in terms of teacher involvement

No	Items	Mean	SD	Descriptive Equivalence
1	My teacher is willing to answer student's questions regarding mathematical concepts.	4.076	0.712	Often
2	My teacher is patient when teaching mathematics.	3.861	0.843	Often
3	My teacher draws attention to mathematics examinations.	3.975	0.768	Often
4	If I request something related to mathematics, me The teacher will explain and answer patiently.	3.760	0.702	Often
5	My teacher is earnest about teaching mathematics.	3.734	0.746	Often
6	My teacher arranges adequate time for teaching every mathematics lesson.	3.835	0.608	Often
7	Before mathematics class, my teacher has enough preparation.	4.025	0.768	Often
8	My teacher explains the mathematics textbook contents in detail.	3.962	0.759	Often
9	My teacher helps students to revise before mathematics tests and examinations	3.861	0.780	Often
Category Mean		3.90	0.55	Often

The findings suggest that first-year students perceive their mathematics teachers as being responsive to questions and well-prepared for classes. Students also observed that teachers often helped them with revisions before tests and examinations, detailed explanations of textbook content, and sufficient teaching time for each lesson. These findings support Huot et al. (2024), emphasizing the crucial role of teacher involvement in fostering students' development through strong teacher-student relationships, goal-setting support, and academic guidance.

4.4 Extent of Classroom Environment in terms of Teacher Support for Students

Table 7 presents the levels of classroom environment in terms of teacher support. The statement "My teacher advises on students' learning progress in mathematics" received the highest mean score of 3.83, followed by "My teacher helps students to set mathematics learning targets" scored 3.77, both categorized as "often," indicating that these practices were observed frequently. However, "My teacher rewards students for progress in mathematics achievements" scored the lowest at 3.34, categorized as "sometimes," indicating that it is observed occasionally. The overall mean of 3.68, interpreted as "often," suggests frequent positive observations. The standard deviation was 0.71, indicating similar perceptions among students regarding teacher support.

Table 7. Extent of classroom environment in terms of teacher support for students

No	Items	Mean	SD	Descriptive Equivalence
1	My teacher rewards students for progress in mathematical achievements.	3.342	0.918	Sometimes
2	My teacher helps students to set mathematics learning targets.	3.772	0.862	Often

3	My teacher encourages students to see whether Our study method is helpful for learning mathematics.	3.696	0.882	Often
4	My teacher advises on students' learning progress in mathematics.	3.835	0.807	Often
5	My teacher praises students' performance in mathematics learning.	3.620	0.836	Often
6	My teacher designs class assignments to allow students to apply mathematical knowledge in daily life.	3.734	0.902	Often
7	My teacher provides strategies for improving mathematics learning for all students.	3.747	0.869	Often
Category Mean		3.68	0.71	Often

The results imply that teachers of first-year students often advise on their mathematics learning progress, guide goal-setting, and provide assignments that encourage the application of mathematical concepts to real-life situations. This finding is consistent with Huang and Wang (2023), who emphasized that teacher support helps students overcome learning challenges, encouraging meaningful course involvement and maintaining academic success.

4.5 Summary of the Extent of Classroom Environment of Students

Table 8 presents a summary of the classroom environment indicators. Collaborative Ness obtained the highest mean score of 4.17, followed by teacher involvement at 3.90, while order and student involvement had the lowest mean of 3.55. All indicators were interpreted as "often," indicating that a conducive classroom environment is observed frequently. Moreover, the classroom environment holds a categorical mean of 3.82, interpreted as "often" suggesting that the classroom environment is observed frequently. The standard deviation was 0.45, indicating similar perceptions among students regarding the classroom environment.

Table 8. Summary of the extent of classroom environment

Indicators	Mean	SD	Descriptive Equivalence
Collaborativeness	4.17	0.58	Often
Order and Student Involvement	3.55	0.61	Often
Teacher Involvement	3.90	0.55	Often
Teacher Support	3.67	0.71	Often
Overall	3.82	0.45	Often

This result implies that first-year students perceive their classroom environment as collaborative and strongly supported by teacher involvement, fostering social connections and academic focus. This finding aligns with Guo et al. (2023), who reported that a supportive classroom climate, characterized by strong teacher-student relationships and task focus, significantly influences academic success.

4.6 Level of Students' Motivation in terms of Intrinsic Goal Orientation

Table 9 presents the results on the level of students' motivation in terms of intrinsic goal orientation. The statement "*I would like to learn the topics that I like, despite the difficulty, in mathematics class.*" obtained the highest mean score of 4.27, which is interpreted as very high, indicating a very high level of motivation. The statement "*The most satisfying thing for me in the mathematics course is trying to understand the content as thoroughly as possible*" ranked second with a mean of 4.04, interpreted as "high." This shows that the students are highly motivated. However, the statement "*Studying mathematics makes me very happy.*" had the lowest mean of 3.61, which was also interpreted as high, demonstrating that students were highly motivated.

Furthermore, the category mean was 3.86, interpreted as high, indicating that the students' motivation in terms of intrinsic goal orientation was high. The standard deviation of 0.55 suggests that the respondents generally shared similar views regarding this aspect of motivation.

Table 9. Level of students' motivation in terms of intrinsic goal orientation

No	Items	Mean	SD	Descriptive Equivalence
1	I would like to learn the topics that I like, despite the difficulty in mathematics class.	4.266	0.655	Very High
2	Studying mathematics makes me happy.	3.608	0.706	High
3	I do my mathematics homework to learn.	3.765	0.710	High
4	In a mathematics class, I prefer course material that really challenges me to learn new things.	3.734	0.796	High
5	The most satisfying thing for me in the mathematics course is trying to understand the content as thoroughly as possible.	4.038	0.649	High
6	When I have the opportunity in the mathematics class, I choose course assignments that I can learn from even if they do not guarantee good grades.	3.747	0.776	High
Category Mean		3.86	0.55	High

These findings indicate that first-year students are eager to learn challenging mathematics topics and find fulfillment in understanding lesson content and completing homework for learning. This result aligns with Suren and Kandemir (2020), who emphasized that intrinsic motivations such as curiosity, personal development, and expertise significantly impact academic achievement, particularly in mathematics.

4.7 Level of Students' Motivation in terms of Extrinsic Goal Orientation

Table 10 presents the students' motivation regarding extrinsic goal orientation. The statement "Getting a good grade from mathematics class makes me very happy" scored the highest mean of 4.27, while "I would like to perform well on the exam so that my understanding of mathematics is reflected positively in my report card," followed closely with a mean of 4.33. Both were interpreted as very high, indicating a high level of motivation. However, the statement "I would like to perform better in mathematics problem-solving than my friends in class" obtained the lowest mean of 3.91 but was still categorized as high, showing that students were highly motivated. Moreover, the category mean was 4.12, which is interpreted as "high," indicating a high level of extrinsic goal orientation. The standard deviation of 0.60 suggests that the respondents shared a similar perception of this motivational factor.

Table 10. Level of students' motivation in terms of extrinsic goal orientation

No	Items	Mean	SD	Descriptive Equivalence
1	Getting a good grade from mathematics class makes me very happy.	4.380	0.704	Very High
2	I would like to perform well on the exam so that my understanding of mathematics is reflected positively in my report card.	4.327	0.690	Very High
3	I would like to perform better in mathematics problem-solving than my friends in class.	3.911	0.963	High
4	I would like to show my friends and family that I can be successful in mathematics classes.	3.987	0.809	High
5	I want to do well in class because it is important to flaunt mathematical ability.	4.000	0.768	High
Category Mean		4.119	0.60	High

The findings indicate that first-year students feel happy receiving good grades in mathematics and aim to perform well on exams to positively reflect their understanding on their report cards. These results

are consistent with Asanre (2024), who found that extrinsic motivators, such as rewards and recognition, can effectively drive students to achieve academic goals.

4.8 Level of Students' Motivation in terms of Task Value

Table 11 presents students' motivation in terms of task value. The statement "*It is important for me to learn the subjects in mathematics class"* received the highest mean score of 4.04, followed by "*I like the subjects of mathematics class"* with a mean score of 3.91. Both were interpreted as "high," indicating high student motivation. However, "*I can use what I learned in mathematics class in other classes"* obtained the lowest mean of 3.76 yet still corresponds to "high," indicating that students' motivation remains high. Furthermore, task value holds a categorical mean of 3.873, interpreted as "high," indicating that the students' motivation in relation to task value is high. The standard deviation of 0.50 indicates that the respondents shared a similar perception of this indicator.

Table 11. Level of students' motivation in terms of task value

No	Items	Mean	SD	Descriptive Equivalence
1	I can use what I learned in mathematics class in other classes.	3.785	0.613	High
2	It is important for me to learn the subjects in mathematics class.	4.038	0.706	High
3	I am interested in the subjects of mathematics class.	3.798	0.740	High
4	I find the subjects taught in mathematics class useful.	3.835	0.706	High
5	I like the subjects in my mathematics class.	3.911	0.804	High
Category Mean		3.873	0.50	High

This finding indicates that first-year students are highly motivated to learn mathematics, value its importance, and enjoy the subject, which leads them to engage deeply and invest effort in their academic journey. This aligns with Wang et al. (2022), who noted that when students perceive mathematics as important and feel competent, their autonomous motivation increases, leading to better academic results.

4.9 Level of Students' Motivation in terms of Learning Belief

Table 12 presents students' motivation levels based on their learning beliefs. The statement "*If I study hard enough, I can learn the subjects of mathematics class"* received the highest mean score of 4.203, interpreted as very high, indicating a very high level of students' motivation. The item "*If I study properly, I can learn the subjects in mathematics class"* had the second highest mean of 4.17, and a high descriptive rating also indicates a very high level of students' motivation. However, "*If I do not understand the subjects in mathematics class, this is because I am not studying hard enough"* obtained the lowest mean of 3.87, which was also categorized as high, demonstrating a high level of students' motivation. Moreover, the category mean was 4.03, interpreted as "high," suggesting that students' motivation possesses high learning beliefs. The standard deviation of 0.57 implies that the respondents shared a similar perception regarding this aspect of motivation.

Table 12. Level of students' motivation in terms of learning belief

No	Items	Mean	SD	Descriptive Equivalence
1	Understanding the subjects in mathematics class is very important.	3.899	0.672	High
2	If I study properly, I can learn the subjects in the mathematics class.	4.165	0.706	High
3	If I cannot learn the subjects in a mathematics class, that is my fault.	3.987	0.809	High

4	If I study hard enough, I can learn the subjects of mathematics class.	4.203	0.687	Very High
5	If I do not understand the subjects in mathematics class, it is because I am not studying hard enough.	3.873	0.807	High
Category Mean		4.03	0.57	High

This result indicates that first-year students believe they can succeed in learning mathematics through consistent effort and effective study habits, which likely increases their motivation to engage with the subject. These results are supported by Pitsia, Biggart, and Karakolidis (2017), who found that students' beliefs about their capability to learn mathematics influence their motivation and academic performance.

4.10 Level of Students' Motivation in terms of Self-efficacy

Table 13 presents the level of students' motivation in terms of self-efficacy, with the highest mean of 4.04 for the statement "If I study mathematics, I think I will get a very good grade" received the highest mean of 4.04, followed by "I am sure I can learn the knowledge taught in mathematics class," which had a mean of 3.82. Both items obtained a high score," indicating a high level of students' motivation. However, "I am sure I can understand the most difficult subjects that the teacher teaches in mathematics class" and "I am sure that I will get a high grade in homework and exams in mathematics class" obtained the lowest mean of 3.633, which is also classified as high, indicating that this student's motivation had a high level of self-efficacy. Furthermore, the overall category mean was 3.74, interpreted as "high," indicating that the students' motivation in terms of self-efficacy was high. The standard deviation of 0.52 suggests that most respondents shared a similar perception of these aspects of motivation.

Table 13. Level of students' motivation in terms of self-efficacy

No	Items	Mean	SD	Descriptive Equivalence
1	If I study mathematics, I think I will get a very good grade.	4.038	0.792	High
2	I am sure I can understand the most difficult subjects in mathematics textbooks.	3.646	0.734	High
3	I am sure I can learn the knowledge taught in mathematics class.	3.823	0.712	High
4	I am sure I can understand the most difficult subjects that the teacher teaches in a mathematics class.	3.633	0.701	High
5	I am sure that I will get a high grade in homework and exams in mathematics classes.	3.633	0.719	High
6	I am sure I will be very successful in mathematics class.	3.658	0.696	High
Category Mean		3.74	0.52	High

These findings show that first-year students have strong self-efficacy in mathematics, leading to confidence in achieving good grades and learning concepts, which enhances their motivation to engage and persist in learning mathematics. These results are supported by Yang, Maeda, and Gentry (2024), who found that mathematics self-efficacy is a key predictor of students' mathematics achievement across different grade levels.

4.11 Summary of the Level of Students' Motivation

Table 14 summarizes the students' motivation levels. Extrinsic goal orientation obtained the highest mean of 4.11, followed by learning belief, with a mean of 4.03. The mean score for self-efficacy was 3.74. All indicators were interpreted as high, indicating that the level of students' motivation in terms of the indicators is high. Moreover, the categorical mean was 3.92, interpreted as "high," indicating

that the students' motivation level was high. The standard deviation of 0.43 shows that respondents shared similar answers for this variable.

Table 14. Summary of the level of students' motivation

Indicators	Mean	SD	Descriptive Equivalence
Intrinsic Goal Orientation	3.86	0.55	High
Extrinsic Goal Orientation	4.11	0.60	High
Task Value	3.87	0.50	High
Learning Belief	4.03	0.57	High
Self-efficacy	3.74	0.52	High
Overall	3.92	0.43	High

The results indicate that first-year students are primarily motivated to learn by external factors, such as grades and recognition, rather than intrinsic motivation. This finding is supported by Diseth, Mathisen, and Samdal (2020), which implies that students tend to exhibit a significantly higher level of extrinsic than intrinsic motivation.

4.12 Summary of the Level of Mathematics Problem-Solving Skills

The overall mean of this variable reached 19.13, with a descriptive equivalent of low, indicating that first-year students' mathematics problem-solving is below satisfactory. The standard deviation of 15.50 also shows a high variation in students' problem-solving scores, as can be seen in Table 15.

Table 15. Summary of the level of mathematics problem-solving skills

Indicators	Mean	SD	Descriptive Equivalence
Problem-solving Skill	19.13	15.50	Low

The findings indicate that first-year students lack essential skills in conceptual understanding, the ability to carry out the plan, and the skill to express their final answers clearly. This confirms (Güner & Erbay, 2021), who found that students struggle to understand problems, identify appropriate solution strategies, apply techniques accurately, and scrutinize the precision of their solutions.

4.13 Test of Normality for Classroom Environment, Students' Motivation and Mathematics Problem-Solving Skills

Table 16 shows that the Kolmogorov-Smirnov and Shapiro-Wilk tests indicated that the classroom environment and students' motivation were normally distributed, as their significance values were greater than 0.05, leading to the rejection of the null hypothesis. Thus, these variables were normally distributed. However, the tests for mathematics problem-solving skills scores produced significance values less than 0.05, indicating that the scores were not normally distributed; thus, the null hypothesis was not rejected. Therefore, the variable mathematics problem-solving skills were not normally distributed.

Table 16. Test of normality for classroom environment, students' motivation and mathematics problem- solving skills

	Kolmogorov-Sminov			Shapiro-Wilk		
	p-value	Decision	Interpretation	p-value	Decision	Interpretation
Classroom Environment	0.200	Reject H_0	Not Significant	0.736	Reject H_0	Not Significant
Students' Motivation	0.200	Reject H_0	Not Significant	0.145	Reject H_0	Not Significant
Problem-Solving Skills Scores	0.200	Reject H_0	Not Significant	0.000	Accept H_0	Significant

4.14 Relationship Between Classroom Environment and Mathematics Problem-Solving Skills

Table 17 indicates a weak positive relationship between the classroom environment and mathematics problem-solving skills, with a p-value of 0.023, leading to the rejection of the null hypothesis. This indicates a significant relationship between the classroom environment and mathematics-problem-solving skills.

Table 17. Relationship between classroom environment and mathematics problem-solving skills

Variables Correlated	rho	p-value	Decision on H_0 at $a = 0.05$	Interpretation
Classroom Environment and Mathematics Problem-Solving Skills	0.255	0.023	Reject H_0	Significant

Klang, Karlsson, Kilborn, Eriksson, and Karlberg (2021) highlight that cooperative learning strategies, which emphasize student interaction and collaboration, can contribute to improved problem-solving skills.

4.15 Relationship Between Students' Motivation and Mathematics Problem-Solving Skills

Table 18 shows a weak positive relationship between students' motivation and their mathematics problem-solving skills, with a correlation coefficient of 0.275. The p-value of 0.014, which is less than the 0.05 significance level, indicates the rejection of the null hypothesis. This indicates a significant relationship between students' motivation and mathematics problem-solving skills.

Table 18. Relationship between students' motivation and mathematics problem-solving skills

Variables Correlated	rho	p-value	Decision on H_0 at $a = 0.05$	Interpretation
Students' Motivation and Mathematics Problem-Solving Skills	0.275	0.014	Reject H_0	Significant

This result is supported by the study of Urhahne (2021) which states that intrinsic and extrinsic motivation can both help develop problem-solving abilities.

4.16 Relationship Between Classroom Environment and Students' Motivation

Table 19 indicates a strong positive relationship between classroom environment and student motivation. The p-value of 0.000, which is less than 0.05, leads to the rejection of the null hypothesis. This indicates a significant relationship between the classroom environment and students' motivation to learn.

Table 19. Relationship between classroom environment and students' motivation

Variables Correlated	rho	p-value	Decision on H_0 at $a = 0.05$	Interpretation
Classroom Environment and Students' Motivation	0.656	0.000	Reject H_0	Significant

Cayubit (2022) supported the assertion that the classroom environment and students' motivation are positively correlated. The results above met the conditions required to proceed with bootstrap regression analysis.

4.17 Regression Path in the Mediation Model

Table 20 shows that the classroom environment significantly predicted students' motivation, leading to the rejection of the null hypothesis and indicating a strong influence.

Table 20. Regression path in the mediation model

Path	Predictor → Outcome	β	SE	t-value	p-value	R^2	Decision	Interpretation
a	Classroom → students' motivation	1.504	0.081	7.777	0.000	0.440	Reject H_0	Significant
b	Students' Motivation → mathematics problem-solving skills	4.713	5.321	0.886	0.029	0.089	Reject H_0	Significant
c'	Classroom environment → mathematics problem- solving skills	9.722	3.770	2.579	0.012	0.079	Reject H_0	Significant

This supports Bandura Social Cognitive Theory, which posits that the environment shapes thoughts and behaviors, including attitudes, values, goals, self-efficacy, and motivation (Aghaziarati, 2025). Students' motivation also significantly predicts mathematics problem-solving skills, indicating a strong influence and supporting Self-Determination Theory, which emphasizes the role of motivation and self-efficacy in learning (Baity, Syaiful, & Muhaimin, 2021).

Moreover, the classroom environment significantly predicted mathematics problem-solving skills, leading to the rejection of the null hypothesis. This aligns with Bronfenbrenner's Ecological Systems Theory, which highlights the impact of environmental systems on development. A supportive environment enhances students' motivation, consistent with the findings of this study. This is further supported by Dolinting and Pang (2022), who found that classroom climate positively influences students' mathematics achievement.

4.18 The Indirect Effect of Students' Motivation on Classroom Environment- Mathematics Problem-Solving Skills Relationship

Table 21 presents the analysis of the indirect effect of students' motivation as a mediator between the classroom environment and mathematics problem-solving skills, showing an indirect effect of 2.964. The 95% confidence interval ranged from -4.033 to 8.877, indicating that the effect was not statistically significant. Thus, student motivation does not mediate the relationship between the classroom environment and mathematics problem-solving skills.

Table 21. The indirect effect of students' motivation on classroom environment- mathematics problem-solving skills relationship

Mediating Variable	Indirect Effect (a × b)	BootSE	BootLLCI	BootULCI
Students' Motivation	2.964	3.154	-4.033	8.877

These findings are supported by Fan and Williams (2018), who indicated that although certain aspects of school climate were linked to motivation, motivation did not significantly mediate the influence between the perceived classroom environment and mathematics achievement.

4.19 The Fully Standardized Effect Size of Mediation (K^2)

Table 22 presents that the bootstrapped confidence interval for the standardized effect size includes zero, suggesting that the mediation effect is not statistically significant. Sanchez et al. (2024) indicated that a K^2 value of approximately 0.01 reflects a low effect, approximately 0.09 indicates a medium effect, and approximately 0.25 represents a high effect. An effect size of $K^2 = 0.086$ is generally viewed as a medium effect. This suggests a moderate mediating role of students' motivation; however, the inclusion of zero in the 95% confidence interval ranges from -0.115 to 0.248 suggests that the mediation should be interpreted with caution, as it is not reliably established.

Although the indirect effect of students' motivation was not statistically significant, this suggests that motivation does not serve as a mediating mechanism between the classroom environment and mathematics problem-solving skills in the study. This implies that the influence of the classroom environment and problem-solving skills operates more directly, where a supportive and structured classroom environment immediately enhances students' engagement and learning opportunities that contribute to problem-solving performance.

Table 22. The fully standardized effect size of mediation (K^2)

Mediating Variable	K^2	BootSE	BootLLCI	BootULCI
Students' Motivation	0.086	0.090	-0.115	0.248

These findings are supported by Al Umairi (2024), who found that despite strong correlations between self-efficacy, motivation, and achievement, the indirect effect of motivation was not statistically significant, showing that self-efficacy directly influenced mathematics achievement without motivational mediation.

4.20 Summary of Mediation Model

Table 23 summarizes the mediation analysis, indicating a significant total effect of the independent variable on the dependent variable, indicating a 972.2% change per-unit increase. The direct effect after mediation was not significant, implying no reliable influence of the independent variable when accounting for the mediator. Similarly, the indirect effect was not significant, indicating that motivation does not significantly mediate the relationship between the classroom environment and problem-solving skills.

Table 23. Summary of mediation model

Effect	Estimate	SE	t-value	p-value	95% CI	Decision	Interpretation
Direct Effect (c') CE→PSS	6.759	5.045	1.340	0.184	[-3.289,16.807]	Accept H_0	Not significant
Indirect Effect (a*b) CE→SM→PSS	2.946	3.154	–	–	[-4.033, 8.877]	Accept H_0	Not significant
Total Effect (c)	9.722	3.770	2.579	0.012	[2.214, 17.230]	Reject H_0	Significant

This study indicates that a positive classroom environment enhances students' mathematics problem-solving skills, regardless of their motivation levels. A higher-quality environment is correlated with improved problem-solving abilities. This finding contradicts the mediation pathway supported by Ryan and Patrick (2001), which states that a positive classroom environment can enhance students' motivation, consequently leading to improved problem-solving skills. In relation to Bandura Social Cognitive Theory, specifically reciprocal determinism, the classroom environment can still directly influence the development of problem-solving skills, even if motivation is not a significant mediating factor.

5. Conclusions

5.1 Conclusion

The study found significant positive correlations between classroom environment and students' motivation, classroom environment and mathematics problem-solving skills, and students' motivation and mathematics problem-solving skills. Regression analysis further confirmed that the classroom environment significantly influenced both students' motivation and mathematics problem-solving skills, while students' motivation also significantly influenced their mathematics problem-solving skills. However, the indirect effect of the classroom environment on mathematics problem-solving skills through students' motivation was not significant, indicating that motivation does not mediate this

relationship. This suggests that while motivation is an important factor, it does not serve as the mechanism through which the classroom environment affects problem-solving skills.

Based on the findings, it is recommended that mathematics teachers adopt strategy-focused instructional practices to improve students' problem-solving skills. Teachers should explicitly teach step-by-step strategies and integrate real-life contextualized problems to enhance understanding and application. Scaffolded instruction, regular practice with timely and process-focused feedback, and collaborative learning activities are also encouraged to strengthen reasoning and engagement skills. Metacognitive strategies can help learners reflect on and improve their thinking processes. Teachers should also apply differentiated instruction to address diverse learning needs and design assessments that emphasize higher-order thinking and multi-step problem-solving. School administrators can support these efforts by providing professional development on effective problem-solving instruction.

5.2 Research Limitations

Due to the study's limited sample size, teachers are encouraged to adapt instructional strategies according to their specific classroom contexts, while policymakers should support broader multisite research to improve the generalizability of the findings. Because survey data alone may not fully capture students' learning experiences, teachers should incorporate reflective and interactive learning approaches, and policymakers are encouraged to promote mixed-methods research designs. Furthermore, because this study only considered selected variables, teachers should implement more holistic learning strategies, and policymakers should develop comprehensive educational programs that address multiple factors influencing student learning outcomes. In addition, given the use of specific assessment tools, teachers are advised to apply varied and authentic assessment methods, and policymakers should strengthen assessment frameworks to ensure validity and alignment with problem-solving competencies.

5.3. Suggestions and Direction for Future Research

In light of the study's findings, teachers should continue fostering a positive classroom environment that encourages participation, collaboration, and open communication through interactive, student-centered activities. Educators are also encouraged to apply instructional strategies such as problem-based learning, real-life applications, guided practice, and step-by-step analysis to strengthen students' problem-solving abilities. In addition, efforts should be made to improve students' self-efficacy by providing encouragement, constructive feedback, and opportunities for successful problem-solving. Schools should support teachers through professional development programs that focus on effective teaching strategies, classroom management, and student engagement in mathematics. Future researchers are encouraged to expand the scope of this study by involving larger and more diverse samples, adding variables such as teaching methods and technology integration, and combining quantitative and qualitative approaches.

Acknowledgement

This research would not have been possible without the guidance and support of several individuals and institutions who generously shared their knowledge, time and expertise. To Almighty God for giving wisdom, strength, and helpful people who shared moral support and monetary blessings. To the Dean of the Institute of Teacher Education, Dr. Arnold M. Duping, for the support and prompt approval of this study. To the Research Project Review Panel headed by Abdul J. Jamara, MAEd, with members Ma'am Jean D. Centina, MST, and Ronald S. Decano, PhD, for their valuable suggestions to help that strengthened this study.

To our thesis adviser, Abel E. Sadji, MSc, for sharing his expertise, effort, and patience in answering the queries of the researcher; to our statistician, Ma'am Anababes T. Catala, MAEd, for her assistance in data handling. To our grammarian, Sir Karl Patrick Amper, PhD, for meticulously reviewing the manuscript and ensuring its clarity and correctness. Sincere gratitude is conveyed to the faculty members, validators, and evaluators for their input and feedback, which played a significant role in formulating and validating the research instruments. Lastly, I would like to thank my family, loved

ones, and friends for their warmth, love, inspiration, and unwavering support, understanding, and sacrifice.

Author Contributions

ARS, SRT, NJE, and BJR contributed to all stages of the research process, including conceptualization, implementation, and evaluation of the study. The researchers collaboratively designed the study, developed the methodology, conducted the data collection and analysis, and interpreted the results. AES helped by providing constructive feedback and guiding researchers toward improvement. All authors were involved in drafting, reviewing, and revising the manuscript and approved the final version for publication.

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