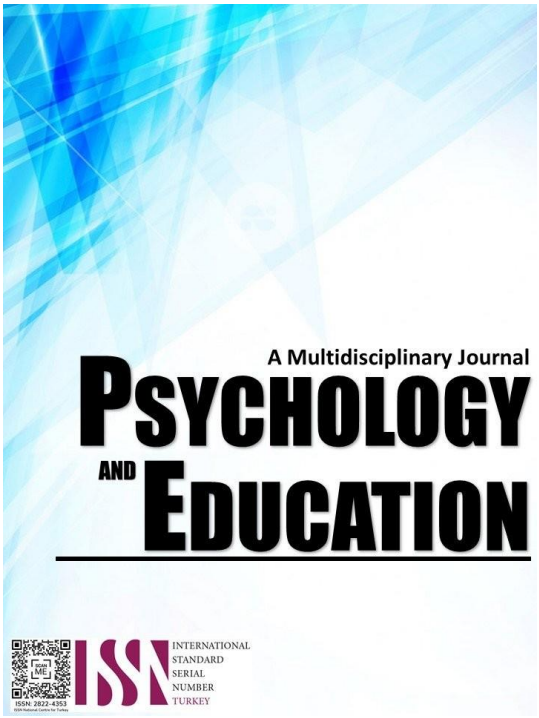
STUDY HABITS, LEARNING ENVIRONMENT AND MATHEMATICS PERFORMANCE OF GRADE 11 STEM STUDENTS



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Research Article

Study Habits, Learning Environment and Mathematics Performance of Grade 11 STEM Students

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Abstract

Mathematics, a cornerstone of STEM education, significantly influences students' academic and career trajectories. This study investigated the relationship between study habits, learning environment, and mathematics performance among 303 Grade 11 STEM students using a descriptive-causal research design. Results showed that students had a high level of motivation and attitude, and a moderately high level of self-efficacy toward mathematics. In terms of the learning environment, students perceived a high level of supportive classroom atmosphere and peer collaboration, while access to resources was rated moderately high. Students' mathematics performance, based on their final grades, fell within the "proficient" level, indicating very satisfactory but improvable performance. Despite the generally positive perceptions of study habits and learning environment, only peer collaboration showed a statistically significant influence on performance. The regression model explained just 3.8% of the variance, suggesting that other unexamined factors such as instructional quality, cognitive ability, and parental involvement may play greater roles. These findings highlight the complexity of academic achievement and the need for comprehensive, targeted interventions to support students in mathematics.

Keywords: *academic outcomes, grade 11 stem, learning environment, mathematics performance, study habits*

Introduction

Mathematics, a foundational subject in STEM education, significantly influences students' academic paths and career aspirations. However, many students struggle to achieve proficiency in mathematics due to various factors. These include poor study habits, lack of critical thinking skills, and ineffective learning environments (Yadav, 2024). Despite its importance, many students struggle to achieve proficiency in mathematics, with their performance. Their inability to think critically, study effectively and poor learning environment negatively impacts their academic and mathematical performance.

Study habits is a part of a student's day-to-day experiences in studying. These study habits are practices that could allow a learner to somehow gain interest while studying without having to feel pressured or bothered. Habit is one of the most important determinants of a student's academic performance (Jafari, 2019). By instilling discipline and structure into the learning process, students can harness their potential and optimize their cognitive abilities. An effective study habit does not only enhance the academic achievement but also contributes to the development of crucial life skills such as self-regulation, perseverance, and critical thinking.

A good study habit is vital for improving learning and retention capacity and which is not difficult to pick up. Undoubtedly, students face many issues in their daily lives which compete for their attention (Ho, 2020). The real challenge lies in managing the many daily distractions students face, which can range from academic pressures to social obligations and personal responsibilities, all competing for their time and focus. Establishing effective study routines requires a conscious effort to prioritize academic tasks, ensuring that learning goals remain at the lead amidst competing demands. Adopting strong study habits provides students with a structured approach to learning, enabling them to navigate their daily responsibilities while maximizing retention and academic performance.

The student's academic performance serves as another variable to determine a student's overall achievement, grade, or academic progress across different courses. Academic performance refers to how poorly or satisfactorily a student performs in the respective courses that they are enrolled in. Thus, academic performance is the primary indicator of a quality learning experience in every school setting, particularly in higher institutions (Magulod, 2019). The performance reflects how well a student comprehends and applies the material they are learning. Academic performance offers critical data that helps educators refine their strategies to ensure that students meet educational objectives. By understanding this, institutions can better identify areas of concern and craft targeted support systems to improve students' academic experiences and outcomes.

Education is a powerful agent of change that improves health and livelihoods and contributes to social stability. At the micro-level, it is associated with better living standards for individuals through improved productivity; given that those who have received higher education tend to have more economic and social opportunities. At the macro level, education builds well-informed and skilled human capital which has been considered an engine of economic growth that positively contributes to economic development (Sothan, 2018).

Education plays a pivotal role in producing qualified human power that accelerates economic development and solves the real problems of a community. Students are also expected to spend much of their time on their education and need to graduate with good academic results. However, the trend of graduating students is not proportional to the trend of enrolled students and an increasing number of students commit readmission, suggesting that they did not perform well in their academics (Mesfin Tadese et al., 2022).

This study investigated the relationship between study habits, learning environment, and Mathematics performance among Grade 11 STEM students. Specifically, it explored how factors such as motivation, self-efficacy, attitudes, supportive classroom atmosphere,

access to resources, and peer collaboration influenced students' academic outcomes. By identifying the predictors of mathematics performance, the study provided insights to guide educators, parents/guardian, and institution in creating interventions and strategies to enhance students' mathematical proficiency and overall academic success.

Research Questions

This study aimed to examine the relationship between study habits, learning environment and mathematics performance among Grade 11 STEM students. Specifically, it answered the following questions:

1. What is the level of Study Habits of the participants in terms of:
    1.1. Motivation;
    1.2. self-efficacy; and
    1.3. attitudes?
2. What is the level of Learning Environment of the participants in terms of:
    2.1. supportive classroom atmosphere;
    2.2. access to resources; and
    2.3. peer collaboration?
3. What is the level of Mathematics Performance of the participants?
4. Is there a significant relationship between Mathematics Performance and
    4.1. study habits; and
    4.2. learning environment?
5. Which of the variables, singly or in combination, predicts the performance of the Grade 11 STEM students in Mathematics?

Methodology

Research Design

This study employed a descriptive-causal research design to examine the relationships of study habits, the learning environment, and the mathematics performance of Senior High School students. The descriptive component aims to provide a detailed account of current study habits, including Motivation, Self-efficacy, and Attitudes, as well as the Learning Environment factors such as Classroom Support, Resource Accessibility, and Peer Collaboration. Additionally, it describes Students Mathematics Performance. By identifying patterns, trends, and areas for improvement, this aspect offers a comprehensive view of the existing dynamics. Descriptive research is particularly suitable for documenting the status quo and understanding the factors that affect it (Aggarwal, 2018).

The causal component investigated how study habits and the learning environment influence mathematics performance. It explored the cause-and-effect relationships between independent variables (study habits and the learning environment) and the dependent variable (mathematics performance). This approach seeks to determine how factors such as motivation, self-efficacy, and classroom dynamics directly impact academic outcomes. Causal research design is appropriate for studies aimed at identifying influencing factors and guiding targeted interventions (Creswell & Creswell, 2018).

Integrating both descriptive and causal research designs ensures a thorough exploration of the research problem. While the descriptive component provides foundational insights into the variables, the causal component examines the strength and direction of their relationships. This dual approach is consistent with previous studies emphasizing the value of combining descriptive and causal methodologies to effectively address complex educational research questions (Fraenkel et.al, 2019). By employing this comprehensive approach, the study seeks to gain a robust understanding of the variables and relationships involved, ultimately informing the development of interventions to enhance mathematics performance among students.

Respondents

The study population for this research consisted of Grade 11 STEM students who were enrolled in Mathematics subjects during the 1st Semester of SY 2024-2025 at Liceo de Cagayan University - Main Campus, Senior High School Department. Data collection involved distributing surveys or questionnaires to the selected participants to gather information about their study habits and learning environment. Additionally, the academic records or first term final grades of the students were collected from the Registrar's office with a permission form from the Senior High School - Main Campus principal.

The sample size was determined using Raosoft, it was a web-based tool used for calculating the appropriate sample size needed for a survey or research study. The calculator takes into account various factors such a population size, desired confidence level at 95%, margin of error of 0.05, and expected proportion or response rate at 50%.

The study employed the proportionate stratified random sampling, a standard statistical technique that would divide a population into distinct subgroups, or strata, based on some shared characteristics (Fleetwood, 2023), where each stratum's sample size corresponded to its population size of the stratum considering the procedure, n = (n/N)*ns, where n = sample, N = population size, and ns = stratum size. (Hayes et al.,2020)

Instrument

An instrument was a tool used for measuring, observing, or documenting quantitative data (Creswell, 2012). The researcher utilized a researcher-made survey questionnaire to examine how study habits and learning environments interacted to affect mathematics performance among students. The survey questionnaire was personally crafted to suit the students' profiles and employed a 5-point Likert scale.

The students' final grades in Mathematics were classified using DepEd Order No. 8, s. 2015, also known as the Policy Guidelines on Classroom Assessment for the K to 12 Basic Education Program. The Department of Education had provided an Electronic Class Record Template, which had been available to all public-school teachers since School Year 2015–2016. This official electronic version allowed for the computation of grades in accordance with the DepEd order (Department of Education, 2015).

The following methods of data analysis guided the organization of data in the study, with the scoring range adopted from the Accrediting Agency of Chartered Colleges and Universities in the Philippines (AACCUP, 2022) and CHED NBC 461, s. 2022. The analysis focused on Study Habits in terms of Motivation, Self-Efficacy, and Attitudes, and Learning Environment in terms of Supportive Classroom Atmosphere, Access to Resources, and Peer Collaboration. The study utilized a 5-point Likert scale for data collection and interpretation, with scoring ranges, descriptive ratings, and interpretations. A scale of 5 (4.51–5.00) indicates "Strongly Agree," interpreted as "Very High," reflecting strong agreement or a very favorable perception of the measured variable. A scale of 4 (3.51–4.50) represents "Agree," interpreted as "High," showing agreement or a favorable perception. A score of 3 (2.51–3.50) corresponds to "Undecided," interpreted as "Moderately High," suggesting neutrality or moderate favorability. Scores of 2 (1.51–2.50) and 1 (1.00–1.50) are rated as "Disagree" and "Strongly Disagree," interpreted as "Low" and "Very Low," respectively, signifying disagreement or unfavorable perceptions.

Procedure

The researcher obtained authorization from the Dean of the School of Teacher Education, the Principal of the Senior High Department and the Registrar through formal letters of permission to conduct the study. After successfully completing the Reliability Test, the researcher submitted the paper to the ethics board for review. The researcher observed and followed the ethical guidelines and formal approaches in the study area. The content of the study underwent careful review by the adviser and the Ethics Board Committee. Thorough screening ensured the quality and dependability of the results and findings. An appropriate manner for gathering data was employed by taking the proper course of action and seeking approval from the participants.

After receiving approval from the Ethics Board and permission from the Principal, the researcher distributed the survey questionnaires to the participants either in hard copy or online formats. Each questionnaire included an attached informed consent form, adhering to ethical standards and ensuring compliance with the Data Privacy Act. For participants below legal age, parental consent was also obtained prior to their participation in the study. The entire process was designed to be brief, requiring only 10-15 minutes for participants to complete the survey. During the data collection process, the researcher provided clear instructions and distributed the questionnaires efficiently. Any questions or clarifications raised by the participants were addressed promptly to ensure their understanding and comfort throughout the procedure.

The informed consent form also stated that there was no guarantee of personal benefit from participating in the study, and that there would be low risk involved in conducting the survey. Participation in the study was voluntary and non-coercive. It was emphasized that all collected data would be handled with the highest level of confidentiality and anonymity. The data collected was stored securely in paper or electronic form for ten years after the completion of the research study; after which time, it will be disposed,such as deleted or shredded. Additionally, a copy of the study was submitted to the School of Teacher Education and made accessible at the main campus.

Data Analysis

The Statistical Package for the Social Sciences (SPSS) was used to analyze all of the survey data collected, with the University Statistician overseeing the statistical computations. The data collected in this study were analyzed using several statistical methods.

For problems 1 and 2, mean and standard deviation were used to assess the level and variability of study habits and the learning environment.

For problem 3, the mean grade was used to evaluate students Mathematics performance, offering a benchmark for academic achievement.

For problem 4, after the test of Normality the researcher used the Spearman correlation to establish the relationship among the variables.

For problem 5, multiple linear regression was used to identify the variables that predicted students Mathematics performance.

Results and Discussion

This section presents the analysis and interpretation of the data gathered from the study.

Problem 1. What is the level of Study Habits in terms of:

1.1 motivation;

1.2 self-efficacy; and

1.3 attitudes?

On the study habits in terms of Motivation, Table 1 shows that the overall mean of 3.57 and standard deviation of 0.655 interpreted as "high". The data implied that participants exhibit a high level of intrinsic and extrinsic motivation toward mathematics. Their desire to achieve high grades, set specific goals, and find personal satisfaction in studying mathematics reflect a high level of commitment and enthusiasm. Additionally, their ability to complete assignments on time and willingness to challenge themselves indicate discipline and perseverance in improving their mathematical skills. This level of motivation is likely to contribute positively to their mathematics performance, as they are consistently engaged in learning and striving for excellence. This finding supports the claim of Ajileye (2021), that student's motivation reflects their determination to succeed academically. Highly motivated students tend to put in more effort and enhance their academic performance. Teachers should assess student's motivation levels to understand their learning attitudes, as instructional strategies also play a crucial role in shaping student's motivation. This finding aligns with Steinmayr et al. (2019), who emphasized that students' self-concepts, task values, and achievement motives are key predictors of academic performance beyond intelligence and prior achievement. Additionally, motivation is recognized as a crucial factor in student success, with teachers playing a significant role in fostering engagement through effective instructional strategies (Ajileye, 2021). Motivated students are more likely to take ownership of their learning, seek additional resources, and consistently review mathematical concepts, ultimately improving their performance.

Among the indicators, the highest mean score was recorded for "I set specific goals for improving my mathematics skills" (M = 3.83, SD = 0.865), followed by "I feel a strong desire to achieve high grades in mathematics courses" (M = 3.72, SD = 0.981). These results conform to the Self-Determination Theory (Ryan & Deci, 2020), which posits that students who set clear academic goals and maintain a sense of autonomy in their learning process exhibit higher motivation and persistence. Similarly, MacCann et al. (2019) found that students who perceive mathematics as relevant to their future careers and set learning goals demonstrate better engagement and performance. Students who set clear academic objectives tend to manage their study time effectively, monitor their progress, and adjust their strategies to improve their skills. For instance, a high school student preparing for standardized tests may set weekly problem-solving goals, use self-assessment tools, and seek guidance from mentors.

On the other hand, the lowest mean scores were observed for "I enjoy challenging myself with difficult mathematics problems" (M = 3.29, SD = 1.016) and "I review my mathematics notes even when no tests or quizzes are scheduled" (M = 3.31, SD = 0.995). These findings suggest that while students value motivation, they may not necessarily enjoy tackling difficult problems or engaging in proactive review habits. This aligns with the research of Meng & Zhang (2023), who noted that students with moderate self-efficacy may hesitate when encountering complex mathematical tasks, affecting their performance. Similarly, Baltà-Salvador et al. (2021) found that self-efficacy and motivation play key roles in fostering problem-solving skills, which are essential for mastering mathematical concepts. In practical applications, students who struggle with challenging problems may be less likely to engage in extracurricular mathematics activities unless encourage.

Table 1. *Level of Study Habits in terms of Motivation, n=303*

Item	*Indicator*	*Mean*	*Standard Deviation*	*Interpretation*
1	I feel a strong desire to achieve high grades in mathematics courses.	3.72	.981	High
2	I set specific goals for improving my mathematics skills.	3.83	.865	High
3	I study mathematics because I find it personally rewarding.	3.61	.862	High
4	I actively participate in mathematics-related study groups.	3.41	.934	Moderately High
5	I enjoy challenging myself with difficult mathematics problems.	3.29	1.016	Moderately High
6	I consistently finish my mathematics assignments on time.	3.78	1.000	High
7	I review my mathematics notes even when no tests or quizzes are scheduled.	3.31	.995	Moderately High
8	I am driven to master new mathematics concepts.	3.44	.911	Moderately High
9	I often challenge myself to improve my performance on mathematics problems.	3.77	.921	High
	Total Mean	3.57	.655	High

***Legend**: 5 (4.51–5.00) – Strongly Agree, Very High; 4 (3.51–4.50) – Agree, High; 3 (2.51–3.50) – Undecided, Moderately High; 2 (1.51–2.50) – Disagree, Low; 1 (1.00–1.50) – Strongly Disagree, Very Low.*

On the study habits in terms of Self-Efficacy, Table 2 shows that the total mean of 3.47 and standard deviation of 0.667 is interpreted as moderately high in self-efficacy. The data implied that student's substantial self-confidence in their mathematical abilities. Believing in their capacity to master challenging topics, understanding complex theories, and feeling prepared for assessments indicates a strong sense of self-efficacy. This confidence enables students to approach mathematical problems independently and efficiently, facilitating quicker learning of new concepts. Such a level of self-assuredness is crucial that high mathematics self-efficacy is associated with

improved performance and reduced anxiety in the subject.

This finding conforms to the result of Meng & Zhang (2023) that students possess a fair degree of confidence in their mathematical abilities but may still experience some uncertainty when faced with complex mathematical concepts and assessments. While they believe they can master difficult topics, understand mathematical theories, and solve problems independently, their confidence is not absolute. This suggests that although they recognize their potential to succeed in Mathematics, they may still struggle with self-doubt in high-pressure situations such as quizzes and exams. This also aligns with another study indicating that students with moderate self-efficacy may hesitate when encountering unfamiliar problems, potentially affecting their academic performance. According to Baltà-Salvador et al. (2021), self-efficacy has been shown to influence academic achievement by fostering problem-solving skills and motivation which are essential for mastering complex mathematical concepts. The findings suggested that while students have a fairly strong belief in their mathematical abilities, targeted interventions such as improving test-taking strategies and reinforcing conceptual understanding may help further enhance their confidence and performance in Mathematics

Table 2. *Level of Study Habits in terms of Self-Efficacy, n=303*

Item	*Indicator*	*Mean*	*Standard Deviation*	*Interpretation*
	Self-Efficacy			
1	I believe I can master even the most challenging mathematics topics.	3.39	.953	Moderately High
2	I feel confident in my ability to understand complex mathematical theories.	3.25	.992	Moderately High
3	I can achieve high scores on mathematics exams when I put in enough effort.	3.67	.962	High
4	I feel prepared for any mathematics quizzes and tests.	3.12	.903	Moderately High
5	I believe I can improve my mathematical understanding with regular practice.	3.85	.988	High
6	I can efficiently organize my study time to enhance my mathematics learning.	3.55	.900	High
7	I can tackle mathematical problems independently.	3.39	.928	Moderately High
8	I believe that with the right preparation, I can solve advanced mathematics problems.	3.74	.922	High
9	I am confident in my ability to learn new mathematical concepts quickly.	3.46	.912	Moderately High
10	I feel sure that I can recall mathematical formulas and principles during exams.	3.31	.951	Moderately High
	Total Mean	3.47	.667	Moderately High

***Legend**: 5 (4.51–5.00) – Strongly Agree, Very High; 4 (3.51–4.50) – Agree, High; 3 (2.51–3.50) – Undecided, Moderately High; 2 (1.51–2.50) – Disagree, Low; 1 (1.00–1.50) – Strongly Disagree, Very Low.*

Results in Table 3 showed that total mean of 3.79 and standard deviation of .688 and which interpreted as having a High level of Study Habits in terms of Attitudes. The interpretation of all indicators as "High" suggests that the participants exhibit a strong and positive attitude toward studying mathematics. This is evident in the high mean scores, which indicate that participants believe studying mathematics will benefit their future careers (M = 3.90) and that having a strong understanding of mathematics will help them excel (M = 3.92). These findings suggest that students recognize mathematics as a valuable subject that can contribute to their success in professional fields, motivating them to develop strong study habits. Additionally, students demonstrate openness to different approaches to problem-solving (M = 3.91) and a willingness to put in extra effort to master challenging mathematical topics (M = 3.90), indicating their perseverance in learning mathematics despite its difficulty. Although all indicators fall within the "High" interpretation, some received relatively lower mean scores. The lowest means were recorded for students' enthusiasm about learning new mathematical concepts (M = 3.58) and their perception of studying mathematics as an enjoyable challenge (M = 3.58). While these scores still indicate a positive attitude, they suggest that some students might struggle with maintaining enthusiasm or enjoyment when faced with complex mathematical concepts. Several factors could contribute to this, including the perceived difficulty of mathematics, the pressure of solving challenging problems, or traditional teaching methods that might not always engage students effectively. The results imply that while students recognize the importance of mathematics, their motivation and enjoyment may fluctuate depending on the difficulty of the topics covered.

This finding conforms to the findings of MacCann et al. (2019) that students hold a strong and positive attitude toward mathematics, which significantly contributes to their academic engagement and performance. Their belief in the subject's relevance to their future careers, enthusiasm for learning new concepts, and enjoyment of solving mathematical problems indicate a deep appreciation for mathematics. Such a mindset fosters persistence, motivation, and resilience in overcoming academic challenges. Research suggests that students with positive attitudes toward mathematics tend to engage more actively in learning, leading to better problem-solving skills and higher academic achievement. Furthermore, the willingness to put in extra effort and explore different approaches to solving problems suggests adaptability and a growth mindset, which are essential traits for excelling in mathematics. Positive attitudes foster engagement, allowing students to approach mathematics with confidence rather than fear, ultimately improving their comprehension and performance. (Abalde & Oco, 2023) Additionally, research highlights that motivation, self-efficacy, and a supportive learning environment play critical roles in shaping students' attitudes toward mathematics and their overall academic achievement (Howard, 2021).

Table 3. *Level of Study Habits in terms of Attitudes, n=303*

Item	*Indicator*	*Mean*	*Standard Deviation*	*Interpretation*
	Attitudes			
1	I believe studying mathematics will benefit my future career.	3.90	.910	High

2	I am enthusiastic about learning new mathematics concepts.	3.58	.906	High
3	I see studying mathematics as an enjoyable challenge.	3.58	.955	High
4	I find mathematics stimulating and interesting to learn.	3.69	.937	High
5	I feel a positive attitude helps me better understand mathematics.	3.80	.923	High
6	I look forward to attending my mathematics classes.	3.76	.938	High
7	I think solving mathematics problems is a useful exercise.	3.85	.903	High
8	I am willing to put in extra effort to master challenging mathematics topics.	3.90	.836	High
9	I believe that a strong understanding of mathematics will help me excel	3.92	.873	High
10	I am open to learning different approaches to mathematics problems.	3.91	.902	High
	Total Mean	3.79	.688	High

***Legend**: 5 (4.51–5.00) – Strongly Agree, Very High; 4 (3.51–4.50) – Agree, High; 3 (2.51–3.50) – Undecided, Moderately High; 2 (1.51–2.50) – Disagree, Low; 1 (1.00–1.50) – Strongly Disagree, Very Low.*

Table 4 presents the summary of the study habits in terms of motivation, self-efficacy, and attitudes. The overall mean score of 3.61, with a standard deviation of 0.609, indicates a generally high level of study habits among the participants. Among the three components, attitudes toward studying mathematics received the highest mean score of 3.79, followed by motivation (M = 3.57) and self-efficacy (M = 3.47), which was rated as moderately high.

These findings indicate that students generally hold positive study habits, particularly in their perception and appreciation of mathematics. Their strong attitudes reflect a recognition of the subject's importance to their future success, willingness to explore different problem-solving strategies, and persistence despite challenges.

These findings align with previous researches highlighting the importance of positive attitudes in academic success. MacCann et al. (2019) found that students who perceive mathematics as relevant to their future careers and who enjoy learning mathematical concepts demonstrate higher engagement and academic performance. Similarly, Abalde and Oco (2023) emphasized that a growth mindset and adaptability in learning mathematics contribute to improved comprehension and problem-solving skills. Furthermore, Howard (2021) underscored the role of motivation, self-efficacy, and a supportive learning environment in shaping students' attitudes and overall academic achievement

The moderately high rating for self-efficacy suggests that while students generally believe in their mathematical abilities, some still experience uncertainty when faced with complex problems and assessments. This finding aligns with Meng and Zhang (2023), who noted that students with moderate self-efficacy might hesitate when encountering unfamiliar problems, potentially impacting their academic performance. Baltà-Salvador et al. (2021) further supported this by emphasizing that self-efficacy influences problem-solving skills and motivation, which are essential for mastering complex mathematical concepts.

Table 4. *Summary Level of Study Habits in terms of Motivation, Self-efficacy and Attitudes, n=303*

Item	*Indicator*	*Mean*	*Standard Deviation*	*Interpretation*
	Study Habits			
1	Motivation	3.57	.655	High
2	Self-efficacy	3.47	.667	Moderately High
3	Attitudes	3.79	.688	High
	Overall Mean	3.61	.609	High

***Legend**: 5 (4.51–5.00) – Strongly Agree, Very High; 4 (3.51–4.50) – Agree, High; 3 (2.51–3.50) – Undecided, Moderately High; 2 (1.51–2.50) – Disagree, Low; 1 (1.00–1.50) – Strongly Disagree, Very Low.*

Problem 2. What is the level of Learning Environment in terms of:

2.1. supportive classroom atmosphere;

2.2. access to resources; and

2.3. peer collaboration?

The results in Table 5 reveal that students perceive their classroom environment as highly supportive, with a total mean score of 3.9564 and standard deviation of 0.61988, interpreted as "high". The highest-rated indicator was the instructor providing clear and helpful feedback (M = 4.23, SD = 0.759), followed by creating an inclusive and positive learning environment (M = 4.15, SD = 0.749).

Table 5. *Level of Learning Environment in terms of Supportive Classroom Atmosphere, n=303*

Item	*Indicator*	*Mean*	*Standard Deviation*	*Interpretation*
	Supportive Classroom Atmosphere			
1	My mathematics classroom environment is supportive and encouraging.	4.02	.743	High
2	My instructor provides clear and helpful feedback.	4.23	.759	High
3	I feel comfortable asking questions in my mathematics class.	3.66	.910	High

4	My instructor creates an inclusive and positive learning environment.	4.15	.749	High
5	I feel that my contributions are valued in my mathematics class.	3.86	.813	High
6	I am encouraged to participate in class discussions.	3.92	.820	High
7	My instructor addresses individual learning needs effectively.	4.01	.789	High
8	I receive adequate support from my instructor outside of class.	3.74	.812	High
9	The classroom environment helps me stay focused on my studies.	3.85	.850	High
10	My instructor uses a variety of teaching methods to enhance learning.	4.13	.743	High
	Total Mean	3.95	.619	High

***Legend**: 5 (4.51–5.00) – Strongly Agree, Very High; 4 (3.51–4.50) – Agree, High; 3 (2.51–3.50) – Undecided, Moderately High; 2 (1.51–2.50) – Disagree, Low; 1 (1.00–1.50) – Strongly Disagree, Very Low.*

These findings suggest that students greatly benefit from an environment where teachers provide guidance, recognize student efforts, and foster an encouraging atmosphere.

These results align with Martin et al. (2021), who emphasized that teacher support is crucial in shaping students' motivation, engagement, and confidence. When students feel valued and supported by their instructors, they are more likely to participate actively in mathematics discussions and persevere through difficult mathematical concepts. Additionally, Monteiro et al. (2021) highlighted that effective teacher feedback enhances student engagement, ultimately leading to improved academic performance. This suggests that teachers should continue to implement constructive feedback mechanisms and foster inclusivity in the classroom to maintain student motivation.

Table 6 examines students' access to essential learning resources, with an overall mean score of 3.86 (SD = 0.641), interpreted as high. The highest-rated indicators were access to online resources and databases for mathematics research (M = 4.03, SD = 0.776) and availability of necessary software for coursework (M = 3.97, SD = 0.841).

Table 6. *Level of Learning Environment in terms of Access to Resources, n=303*

Item	*Indicator*	*Mean*	*Standard Deviation*	*Interpretation*
	Access to Resources			
1	I have access to school library for my mathematics studies.	3.76	.886	High
2	I have access to necessary software for my mathematics coursework in school.	3.97	.841	High
3	I have reliable internet access for my mathematics studies.	3.98	.844	High
4	I have access to a computer/laptop for my mathematics assignments.	3.94	1.003	High
5	I have access to online resources and databases for mathematics research.	4.03	.776	High
6	I can easily access textbooks and other learning materials in our school library.	3.58	.837	High
7	The school provides adequate resources for mathematics students.	3.78	.806	High
8	I have access to study spaces conducive to learning mathematics.	3.79	.838	High
9	Overall Mean	3.86	.641	High
10	Access to Resources			
	Total Mean	3.95	.619	High

***Legend**: 5 (4.51–5.00) – Strongly Agree, Very High; 4 (3.51–4.50) – Agree, High; 3 (2.51–3.50) – Undecided, Moderately High; 2 (1.51–2.50) – Disagree, Low; 1 (1.00–1.50) – Strongly Disagree, Very Low.*

These results are consistent with Howard (2021), who asserted that access to digital resources enhances students' ability to grasp complex concepts, particularly in mathematics. Digital tools, such as interactive simulations, graphing software, and online tutorials, provide students with additional means to visualize abstract mathematical ideas, ultimately improving their comprehension and problem-solving skills.

However, it is noteworthy that access to physical textbooks and school library resources received a slightly lower rating (M = 3.58, SD = 0.837), suggesting a potential gap in traditional learning materials. This finding aligns with Liao and Wang (2015), who emphasized that while digital learning resources are beneficial, printed materials remain essential for reinforcing conceptual understanding and improving retention. A well-balanced learning environment should integrate both digital and physical resources to cater to diverse learning preferences and enhance student success in mathematics.

Table 7. *Level of Learning Environment in terms of Peer Collaboration, n=303*

Item	*Indicator*	*Mean*	*Standard Deviation*	*Interpretation*
	Peer Collaboration			
1	I frequently collaborate with my peers on mathematics assignments.	3.90	.865	High
2	I participate in study groups for mathematics.	3.73	.960	High
3	My peers are supportive in helping me understand mathematics concepts.	4.00	.750	High
4	I feel comfortable discussing mathematics problems with my peers.	3.95	.826	High
5	I often exchange study materials with my peers.	3.81	.878	High
6	I receive constructive feedback from my peers on mathematics	3.97	.761	High

	assignments.			
7	My peers and I share effective study strategies for mathematics.	3.89	.831	High
8	I work on group projects with my peers in mathematics classes.	3.90	.846	High
9	Collaborative learning with peers enhances my understanding of mathematics.	4.07	.752	High
10	I feel motivated to improve my mathematics performance through peer collaboration.	4.08	.770	High
	Overall Mean	3.93	.649	High

***Legend**: 5 (4.51–5.00) – Strongly Agree, Very High; 4 (3.51–4.50) – Agree, High; 3 (2.51–3.50) – Undecided, Moderately High; 2 (1.51–2.50) – Disagree, Low; 1 (1.00–1.50) – Strongly Disagree, Very Low.*

Table 7 highlights the role of peer collaboration in students' mathematics learning experiences, with an overall mean of 3.93 (SD = 0.649), interpreted as high. The data indicate that students frequently collaborate with their peers on mathematics assignments (M = 3.90, SD = 0.865) and actively participate in study groups for mathematics (M = 3.95, SD = 0.806). Peer support plays a crucial role in understanding mathematical concepts, as shown by a mean of 4.00 (SD = 0.750), reinforcing the positive impact of collaborative learning.

Additionally, students feel comfortable discussing mathematics problems with their peers (M = 3.95, SD = 0.826) and often exchange study materials (M = 3.81, SD = 0.878), which further enhances their learning experience. Constructive feedback from peers on mathematics assignments (M = 3.82, SD = 0.786) and the sharing of effective study strategies (M = 3.89, SD = 0.831) contribute to improved academic performance. Furthermore, students engage in group projects in mathematics classes (M = 3.85, SD = 0.812), indicating an active and cooperative learning environment.

Notably, collaborative learning is perceived as enhancing students' understanding of mathematics (M = 4.07, SD = 0.750), and students feel motivated to improve their mathematics performance through peer collaboration (M = 4.08, SD = 0.770). These findings suggest that peer collaboration fosters an engaging and supportive academic atmosphere that positively influences students' learning experiences and mathematical competencies.

These findings align with Jones (2023), who emphasized that collaborative learning enhances comprehension by encouraging students to discuss, explain, and justify their mathematical reasoning. Working with peers allows students to explore multiple approaches to problem-solving, leading to a deeper and more meaningful understanding of mathematical concepts. Additionally, Affuso et al. (2022) found that students who actively participate in study groups develop stronger problem-solving skills, critical thinking abilities, and academic resilience. The presence of peer support also increases motivation and reduces mathematics anxiety, particularly when students engage in cooperative learning strategies such as peer tutoring and group discussions.

Table 8 presents a summary of the overall learning environment, integrating supportive classroom atmosphere, access to resources, and peer collaboration. The overall mean score of 3.91 (SD = 0.548) confirmed that students perceive their learning environment as highly favorable. Among the three components, the highest-rated factor was supportive classroom atmosphere (M = 3.96), followed by peer collaboration (M = 3.93) and access to resources (M = 3.86), all interpreted as "high"

The results further support Martin et al. (2021) and Monteiro et al. (2021), who advocated for inclusive environments and clear teacher feedback as drivers of student engagement and performance. Peer collaboration also emerged as a vital factor. As noted by Jones (2023) and Affuso et al. (2022), collaborative learning improves comprehension, critical thinking, and academic resilience while reducing anxiety an insight aligned with the students high rating in this area.

These findings support the research of Baltà-Salvador et al. (2021), which highlighted that a well-structured and resource-rich learning environment significantly enhances student engagement, motivation, and academic success. When students have access to effective teaching strategies, collaborative learning opportunities, and educational resources, they are more likely to develop strong study habits and positive attitudes toward mathematics.

Furthermore, Khalfaoui et al. (2020) emphasized that a supportive classroom climate fosters intellectual curiosity, self-confidence, and resilience, all of which are essential for success in mathematics. The results suggest that schools should continue investing in teacher training, collaborative learning programs, and resource development to maintain an optimal learning environment for students.

Table 8. *Summary Level of Learning Environment in terms of Supportive Classroom Atmosphere, Access to Resources and Peer Collaboration, n=303*

Item	*Indicator*	*Mean*	*Standard Deviation*	*Interpretation*
	Learning Environments			
1	Supportive Classroom Atmosphere	3.96	.619	High
2	Access to Resources	3.86	.641	High
10	Peer Collaboration	3.93	.649	High
	Overall Mean	3.91	.548	High

***Legend**: 5 (4.51–5.00) – Strongly Agree, Very High; 4 (3.51–4.50) – Agree, High; 3 (2.51–3.50) – Undecided, Moderately High; 2 (1.51–2.50) – Disagree, Low; 1 (1.00–1.50) – Strongly Disagree, Very Low.*

Problem 3. What is the level of Mathematics Performance of the students?

Table 9 shows the level of the student mathematics performance in their first-term grades. The data revealed that the level of the students' mathematics performance in their first-term grades in both General Mathematics and Pre-calculus was verbally interpreted as very satisfactory, with a mean and standard deviation of 85 and 5.09, respectively.

Table 9. *Descriptive Statistics on the Level of Students' Mathematics Performance of the students in terms of their first-term final grades (n=303)*

Ratings	*General Mathematics*				*Pre-Calculus*				*Interpretation*
	Freq	*%*	*Mean*	*Std.*	*Freq*	*%*	*Mean*	*Std.*	
90 – 100	72	24			63	20			
85 – 89	130	43			99	33			
80 – 84	67	22	85.82	5.260	80	26	85	5.960	
75 – 79	25	8			50	17			Very Satisfactory
Below 75	9	3			11	4			
Average Mean (GenMath & PreCalc)	85								
Std. Deviation	5.09								

***Legend**: 90–100 – Advanced, Outstanding; 85–89 – Proficient, Very Satisfactory; 80–84 – Approaching Proficiency, Satisfactory; 75–79 – Below Proficiency, Fairly Satisfactory; Below 75 – Significantly Below Proficiency, Did Not Meet Expectations.*

Moreover, the mean and standard deviation of General Mathematics are 85.82 and 5.260 respectively, which is verbally interpreted as very satisfactory while the mean and standard deviation of the Pre-Calculus are 84.89 and 5.960 respectively which is verbally interpreted as satisfactory. This is confirmed in the study of Padernal and Diego (2020), which revealed that the level of academic performance in Pre-Calculus of senior high school students was generally satisfactory regardless of their school of origin and entrance or examination scores. Similarly, Palumar (2024) that satisfactory performance in General Mathematics, with students employing metacognitive, cognitive, and collaborative strategies at a high level. Tambaoan and Gaylo (2019) observed very satisfactory performance in Basic Calculus when using differentiated instruction, which significantly outperformed conventional methods. Mirabueno and Boyon (2020) identified significant relationships between Grade 11 mathematics performance.

Problem 4. Is there a significant relationship between Mathematics Performances and

4.1 study habits; and

4.2 learning environment?

Table 10. *Spearman Correlation of Mathematics Performance of Grade 11 Stem Students and study habits, and learning environments, n=303*

Variables	*Mathematics Performance*	*p-value*	*Interpretation*
Study Habits	-.097	.095	*Not Significant*
Motivation	-.031	.585	*Not Significant*
Self-efficacy	-.080	.164	*Not Significant*
Attitudes	-.091	.115	*Not Significant*
Learning Environment	.086	.135	*Not Significant*
Support	-.063	.278	*Not Significant*
Access	.006	.915	*Not Significant*
Collaboration	.111	.053	*Not Significant*

Note: Correlation using 0.05 level of significance (α = 0.05).

The results on Table 10 show the Spearman correlation results on the relationship between the Mathematics Performance of Grade 11 STEM students and study habits as well as the learning environment. In terms of study habits, a correlation coefficient of -0.097 with the p-value of 0.095 which indicated no significance in the student Mathematics Performance. In terms of learning environments with the correlation coefficients of 0.086 and p- value of 0.135 indicated that no significance in the student's Mathematics Performance. Therefore, the null hypothesis is their significant relationship between the Mathematics Performance of Grade 11 STEM students, Study Habits, and Learning Environment. This result indicates that there is not enough evidence that the Study Habits and Learning Environment are related to the Mathematics Performance.

The normality test results using both Kolmogorov-Smimov and Shapiro-Wilk test for the average Learning Environment, Average Supportive Classroom Atmosphere, average Access to Resources and average Peer Collaboration indicate that most variables deviate significantly from normality. Both tests show p-value below 0.05 indicating a slight deviation, suggesting that these variables are not normality distributed.

The same test of normality was made for the Mathematics Performance. It shows a p-value from the Shapiro-Wilk test below 0.05, suggesting a significant deviation from normality. All these imply that the data from these variables are not normally distributed. Thus, non-parametric test should be considered as an alternative to parametric methods.

Overall, the data set is not fit for the utilization of Pearson's correlation due to a normality problem. Hence, the utilization of Spearman's correlation is recommended for a more robust result.

One possible explanation for the lack of a strong correlation between attitudes and academic performance is that attitudes alone do not define success. This aligns with the findings of Bangkok et al. (2021), who argued that students' attitudes toward the academic setting do not necessarily determine their level of success. Their study found no significant relationship between students' academic attitudes and their performance, challenging the common assumption that a positive attitude always leads to better academic outcomes.

Furthermore, Martin et al. (2021) highlighted the challenges students face in adapting to mathematics instruction, particularly in online settings. Their study suggested that the lack of face-to-face interaction and immediate feedback negatively impacts comprehension, indicating that external factors beyond personal study habits may contribute to mathematics performance. This indicates that students still prefer their teacher's presence during the teaching and learning process. While this support helps improve their performance, they have yet to develop full independence as learners. Therefore, teachers should provide essential guidance to help students achieve their academic goals. The effectiveness and productivity of the teaching and learning process can be enhanced through the implementation of various teaching strategies, particularly in delivering remedial activities. These remedial activities can enhance students' performance in mathematics. (Oco & Comahig, 2023)

Problem 5. Which of the variables, singly or in combination, best predicts the performance of the Grade 11 STEM students in Mathematics?

Table 11 presents the results of the multiple regression for mathematics performance in terms of the Study Habits and Learning Environments after normalizing the data.

Table 11. *Regression Analysis for Study Habits and Learning Environment, n = 303*

Variables	*Unstandardized Coefficients*		*Standardized Coefficients Beta*	*t*	*Sig.*	*Interpretation*
	B	*Std. Error*				
(Constant)	3.875	0.392		9.897	.000	
Motivation	.094	.113	.072	.826	.410	Not Significant
Self-Efficacy	-.057	.111	-.043	-.508	.612	Not Significant
Attitudes	-.162	.106	-.128	-1.526	.128	Not Significant
Supportive Classroom Atmosphere	-.172	.101	-.126	-1.695	.091	Not Significant
Access to Resources	-.009	.094	-.007	-.096	.923	Not Significant
Peer Collaboration	.258	.096	.195	2.691	.008	Significant

Note: R^2= 0.038, F = 1.948, Sig. = 0.73
Dependent: Student Mathematics Performance
Source: Results of primary data processed using SPSS version 26.0 (2019)

The R-value of 0.195 indicated a moderate positive correlation between the predictor variable and the students' mathematics performance. The R^2 value of 0.038 indicated that the predictors explain the variability of the students' mathematics performance. This means that 3.8% of the students' mathematics performance was attributed to the sub-variable which is the Peer Collaboration while the remaining 96.5% was attributed to other variables not included in the study.

The data also reveal that the regression output showed that the predictor variables are the following: Motivation (.410 > 0.05), Self-Efficacy (.612 > 0.05), Attitudes (.128 > 0.05), Supportive Classroom Atmosphere (.091 > 0,05), and Access to resources (.923 > 0.05). The variables are statistically not significant because their p-values were greater than the level significance of 0.05. This means that these predictor variables do not significantly contribute to the students' Mathematics performance. It may be more heavily influenced by other factors not included in the model, such as cognitive ability, prior knowledge, instructional quality, or parental support. Additionally, the relationship between study habits and performance might be more complex, potentially moderated or mediated by other variables. The motivation is crucial for learning, its impact on performance may only become evident when combined with effective learning strategies or strong foundational knowledge in Mathematics. These findings highlight the complexity of academic performance and suggest that other influential factors should be considered in future research. Understanding the interplay between various cognitive, behavioral, and environmental factors may provide deeper insights into what truly drives students' success in Mathematics.

Furthermore, the non-significance of the learning environment variables, such as a supportive classroom atmosphere and access to resources, suggests that these factors alone may not be sufficient to enhance Mathematics performance. Students might require more personalized instructional support or targeted interventions that go beyond general classroom conditions. Additionally, access to resources does not necessarily guarantee effective utilization, meaning students must also possess the skills and strategies to use available materials efficiently to improve their academic outcomes.

Besides, the Peer Collaboration (.008 < 0.05) was statistically the only predictor variable that best influence the students' Mathematics performance. Therefore, the null hypothesis was accepted. The coefficient is 0.258, and the p-value is 0.008, indicating a significant

positive effect on Students' Mathematics Performance. This suggests that increased collaboration is associated with higher Math scores. The Peer Collaboration is the only predictor with a significant effect on Students' Mathematics Performance, with a positive relationship.

Research on factors influencing mathematics performance highlights the importance of peer collaboration and teacher influence. Peer groups significantly impact students' attitudes, study habits, and achievement in mathematics at the university level. Positive peer interactions foster collaboration, motivation, and deeper understanding of mathematical concepts, leading to improved performance. Conversely, negative peer influences, such as social distractions and peer pressure, can hinder academic progress (Mrope, 2024).

In the study of Adewuyi and Gbolade (2024), peer collaboration was the only significant predictor of students' mathematics performance but the relationships between motivation and self-efficacy, and motivation and locus of control, were not significant. Conversely, Abu and Eu (2014) findings that peer influence or collaboration had a weak association with achievement in mathematics and the attitude of students, interest and strategy of teachers' teaching the subject had a positive association with students' achievement in Mathematics.

Finally, Alphonse and Mugiraneza (2024) found that 93.1% of students acknowledged that peer-learning practices positively influenced their mathematics grades. Moreover, peer learning recognized as a form of collaborative learning has garnered significant attention in educational settings due to its potential to enhance students understanding and retention of subject matter.

Likewise, Khalfaoui et al. (2020) highlighted the importance of peer interactions in fostering collaboration and community, further validating the role of peer collaboration in academic success.

Conclusions

Based on the findings of the study, the following conclusions are drawn:

The level of study habits of the Grade 11 STEM students in terms of motivation and attitudes was found to be high, while their self-efficacy was moderately high. This suggests that most students are generally motivated and maintain a positive disposition towards mathematics, although some still lack full confidence in their capabilities. These findings imply that while students are committed and enthusiastic, efforts should be made to further strengthen their confidence in solving mathematical problems. In terms of the learning environment, the participants perceived a high level of supportive classroom atmosphere and peer collaboration, while access to resources was rated moderately high. This indicates that students benefit from positive interactions with teachers and peers, but may still face challenges related to accessibility and availability of learning materials and technology. The students' mathematics performance, based on their final grades, falls under the "proficient" level, signifying a very satisfactory academic standing. However, this also reflects that there remains room for improvement in order to achieve a more advanced level of performance. Among all the variables tested, only peer collaboration showed a statistically significant relationship with mathematics performance. This finding emphasizes the importance of cooperative learning and student interaction in understanding and applying mathematical concepts more effectively. The results of the multiple regression analysis revealed that peer collaboration was the only significant predictor of mathematics performance among the study habits and learning environment variables. This confirms the value of peer-based strategies and group learning in enhancing academic outcomes in mathematics.

Based on the findings of this study, the following recommendations are proposed to enhance students' mathematics performance by improving study habits and learning environments. These recommendations aim to support educators, schools, researchers, and policymakers in implementing strategies that foster student engagement, motivation, and academic success in mathematics. Academic Institutions could support programs like study groups, peer tutoring, and math review sessions where students can work and learn together. Schools could consider integrating structured and unstructured independent learning techniques into the curriculum to enhance student engagement and improve mathematics performance. The Senior High School Department could incorporate more group-based tasks into the curriculum, allowing students to learn through teamwork. These tasks could be designed to encourage cooperative problem-solving, critical thinking, and the sharing of different perspectives. This would not only promote academic learning but also help students build essential life skills, such as communication and collaboration, which are valuable both academically and professionally. Faculty and administrators could collaborate to create a classroom environment where students feel comfortable helping and learning from one another. This could be achieved by implementing structured study programs, providing mentorship opportunities, and establishing an atmosphere that encourages mutual support. A positive classroom culture that fosters individual discipline and motivation would help students feel more confident in their abilities and willing to take risks in their learning. Parents and guardians could also support this by encouraging their children to study with classmates or friends. Schools could facilitate parent involvement programs that educate guardians on fostering a positive home learning environment for students. Students themselves could take the initiative in their learning by actively participating in group discussions, seeking help when needed, and helping their peers understand lessons. By engaging in peer-assisted learning, students could enhance their comprehension and retention of mathematical concepts. Future researchers could explore how peer collaboration could help improve academic performance in other subjects and among different types of learners.

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