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The Impact of Blended Learning on Self-Concept, Motivation, and Self-Efficacy in Mathematics Performance

Raul M. Marin*, Janice A. Bolen-Amparo
Graduate School, University of Saint La Salle, Bacolod City, Philippines

*Corresponding Author Email: s2060074@usls.edu.ph

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Abstract. This causal research examined how blended learning influences the relationship between students' self-concept, motivation, self-efficacy, and performance in Basic Calculus. It was undertaken to address the difficulties and poor performance of the students in Basic Calculus utilizing the promising benefits of blended learning instruction. This study aimed to determine the direct and indirect effects of blended learning on mathematics performance, as well as the mediating effects of blended learning on self-concept, motivation, and self-efficacy about mathematics performance. A survey was conducted with 220 STEM senior high school students to assess their self-concept, motivation, self-efficacy, and perceptions of blended learning. At the same time, their fourth-quarter exam scores reflected their performance. Correlational analysis revealed that self-concept, self-efficacy, and perceptions of blended learning were significantly associated with mathematics exam results. Path analysis revealed that self-concept, self-efficacy, and blended learning have significant positive direct effects on mathematics performance. Results showed that blended learning instruction can significantly predict improved achievement of mathematical concepts in introductory calculus among students. Mediation analysis revealed that self-concept and self-efficacy had a positive impact on performance, but blended learning did not significantly mediate these relationships. Motivation did not directly affect performance and was not mediated by the blended learning approach. These findings suggest that blended learning may not have a strong influence on math performance in this setting, highlighting the need to explore other factors that impact blended learning as a mediating variable on learning outcomes.

Keywords: Blended learning; Mathematics performance; Motivation; Self-concept; Self-efficacy.

1.0 Introduction

Earlier studies on mathematical self-concept, motivation, self-concept, and mathematics achievement have shown significant controversies; however, mathematics achievement is substantial. This study adopts a causal research method, with a sample of 220 senior high school students from five schools in Romblon. The aim is to primarily explore the mediating role of blended learning instruction in the relationship between self-concept, motivation, self-efficacy, and mathematical achievement.

In a study, Vaksalla (2019) explained that blended learning, which integrates the benefits of online and face-to-face instruction, effectively improves learning outcomes by increasing students' commitment and enhancing their learning. However, its implementation in secondary education, especially in developing countries like the

Philippines, faces various challenges, including infrastructure limitations, pedagogical challenges, and socio-economic factors. Abdisa et al. (2025) emphasized that the successful implementation of blended learning requires an engaging, interactive, and personalized approach to education, addressing diverse learning needs and fostering deeper conceptual understanding. In a national news article published in May 2023, Mendoza (2023) reported that, in response to extreme temperatures, the Department of Education (DepEd) authorized school leaders to suspend face-to-face classes and transition to blended learning to ensure the continuous and safe delivery of education. According to Chi (2023), the Commission on Human Rights (CHR) also supported this move, as it aligns with children's rights and labor standards for safe school environments.

Sevillano (2022) opined that DepEd's continued endorsement of blended learning reflects a broader goal of creating flexible, inclusive, and accessible education, which supports mastery of concepts and prepares students for future opportunities. Fenech et al. (2021) further argued that such learning environments offer learners structure and support, with the promise of flexibility, personalized learning, ease of accessibility, and enhanced student engagement. Tong et al. (2022) confirmed that blended learning significantly improves student engagement by increasing student interactions with teachers and improving students' academic achievement, self-study abilities, and learning attitudes.

Psychological factors such as self-concept, motivation, and self-efficacy are recognized as key predictors of student learning and achievement. For example, Chen et al. (2022) reported that self-efficacy has a direct and significant effect on English language learning outcomes, while self-concept has an indirect impact on these outcomes through its influence on self-efficacy. According to Zou (2025), students with stronger math motivation tend to exhibit higher math self-efficacy, which in turn affects their academic performance. Wang et al. (2022) established through empirical research in STEM education the associations between motivation and mathematics achievement. Chepkerui and Huang (2021) also confirmed that motivation mediates the relationship between self-concept and academic performance. In another study, Pizon and Ytoc (2023) found that motivation, attitude, and teaching strategies significantly predicted mathematics performance. These findings suggest that students' self-efficacy, motivation, and self-concept must be nurtured to improve educational outcomes, particularly in mathematics. Although many studies, such as those by Suren & Kandemir (2020) and Ding et al. (2024), have examined the relationships among self-efficacy, motivation, self-concept, and academic achievement, the results have been inconsistent. Zou & Mustakim (2024) observed that while numerous studies attempt to explain math achievement, few delve deeply into the relationships between variables and how they collectively contribute to explaining math achievement. Therefore, investigating the relationships between self-concept, motivation, self-efficacy, and academic performance is necessary.

Basic Calculus is a core subject in the STEM strand of the Senior High School curriculum. It involves concepts such as limits, continuity, derivatives, and integrals. Many students struggle to learn these concepts despite their importance and broad applicability. Perante (2022) found that most K-12 graduates were not mathematically ready for college, indicating a lack of skills in higher-level math such as Calculus. Domondom et al. (2022) identified the difficulty causes as limited understanding, confusion with formulas and processes, and a lack of time and confidence in learning the subject. Giangan and Gurat (2022) emphasized that students' perceptions of learning Calculus significantly influence their performance, making it essential to understand their cognitive and emotional responses to the subject. In Romblon and other provinces, many topics in Basic Calculus remain untaught due to disturbances, student absenteeism, and lack of readiness. Various disruptions of classes in the Philippines are most often caused by climate-related events, health crises, and local celebrations, usually resulting in the adoption of alternative learning modes such as blended learning. Hence, teachers rely on modular and blended instruction to ensure continuity, but challenges remain.

Given the pressing issues of poor understanding and low mathematics performance among students in Basic Calculus, and the growing recognition of blended learning's potential to address these issues, this study examined the relationships among self-concept, motivation, self-efficacy, and mathematics performance in Basic Calculus among STEM senior high school students. Specifically, it aimed to explore the direct and indirect effects of these psychological factors on students' perceptions of blended learning, as well as their mathematics performance, and the mediating role of blended learning on self-concept, motivation, self-efficacy, and mathematics performance in Basic Calculus among STEM senior high school students. The findings are expected to offer theoretical and practical insights into how blended learning and internal student factors contribute to learning success in Basic Calculus, ultimately guiding the improvement of instructional strategies in the senior high school setting.

2.0 Methodology

2.1 Research Design

This study employed a causal research design to identify cause-and-effect relationships between independent and dependent variables and to construct a path model illustrating the factors influencing the learning performance of 220 STEM senior high school students in Basic Calculus. It focused on self-concept, motivation, self-efficacy, blended learning instruction, and mathematics performance, exploring both direct and indirect effects among these variables. The design enabled the researcher to determine whether the independent variables had a direct or mediated influence on the dependent variable. As Gall et al. (2007) explain, causal design is a non-experimental investigation used to identify cause-and-effect relationships by comparing groups in which the independent variable is either present or absent. The STEM students were randomly assigned to independent groups without researcher manipulation. They were purposively selected since they were the only group taking the Basic Calculus subject, thus making the study non-experimental. According to Creswell (2015), causal or explanatory research is a quantitative design that determines whether changes in one variable lead to changes in another, often using surveys and statistical analysis. In this study, the independent variables were self-concept, motivation, self-efficacy, and blended learning instruction (categorical variables); the mediating variable was students' blended learning experiences; and the dependent variable was mathematics performance, measured through final examination scores (continuous data).

2.2 Research Participants

To enroll a considerable number of STEM senior high school students in the Basic Calculus subject, five national high schools on Tablas Island, Romblon, were selected as the study sites during the second semester of the 2023–2024 school year. Among the total number of Grade 11 STEM students in the five selected schools, 220 participants were included in the study. Only those who signified their willingness to join the research and completed the informed consent forms—duly signed by the students, their parents or guardians, and an impartial witness—were allowed to participate. The researcher discussed the form's contents to ensure voluntary and non-coercive recruitment. These schools were selected because they were the only senior high schools on the island with a high number of enrolled STEM students. The researcher assisted the researcher in completing the informed consent forms, along with the subject teacher, school principal, and an impartial witness, either the mathematics head teacher or a master teacher.

2.3 Research Instruments

Four specifically adapted questionnaires were administered to STEM senior high school students enrolled in Basic Calculus during the second semester of the school year 2023–2024 to investigate the direct and mediating effects of blended learning on self-concept, motivation, self-efficacy, and mathematics performance. The instruments measured Basic Calculus self-concept, Basic Calculus motivation, Basic Calculus self-efficacy, and perceptions on blended learning using 25-item, five-point Likert scale questionnaires adapted from Ayodele (2011), Staribratov and Babakova (2019), Negara et al. (2020), and Balce (2017), respectively. The questionnaires were all adapted from the foreign-authored questionnaires and were modified within the context of Basic Calculus. To determine its suitability for the target population and the specific Basic Calculus concepts, the adapted questionnaires were validated for content and face validity through expert evaluation and feedback from mathematics educators. The final items were refined based on Lawshe's Content Validity Index. Reliability testing using Cronbach's Alpha was conducted among 35 Grade 12 STEM students who had previously taken Basic Calculus, with only items scoring between 0.7 and 0.9 retained, following the criteria from the DATAtab Team (2025). The questionnaires underwent additional validity and reliability testing to minimize cultural biases inherent in foreign-based instruments. Hyman et al. (2006) noted that validated instruments are most effective when used in similar environments, reducing the researchers' burden of creating new tools. Students' mathematics performance was assessed using a unified 40-item fourth-quarter examination aligned with the DepEd course outline and MELCs. The unified achievement test was also subjected to face and content validation, as well as reliability testing, before administration.

2.4 Data Gathering Procedure

Data collection took place from April 5 to May 15, 2024, during class hours or asynchronous sessions, after obtaining permission from the school principals and subject teachers. The researcher first received approval from the school division superintendent, which was then communicated to the principals, teachers, students, and parents. Since Basic Calculus was scheduled for three meetings weekly and considering the schools' distances, the researcher visited each of the five schools once a week over five weeks. Researcher-formulated questionnaires

were personally delivered to the subject teachers or mathematics department heads. The researcher guided and monitored the teachers during the administration of the questionnaire. The completed questionnaires were retrieved and submitted to the researcher for tabulation and analysis, with all student responses kept anonymous and confidential. The first page of the survey included an informed consent form stating the study's purpose, the voluntary nature of participation, and assurances that participation would not affect grades. The succeeding pages are the survey items. Students completed the questionnaires in school under the supervision of their teachers and the researcher. Learner engagement was observed through various assessment tasks, including classwork, assignments, reports, portfolios, quizzes, tests, and a final examination. Students' perceptions on blended learning instruction were gathered at the end of the fourth quarter. According to Owan et al. (2018), data conversion involves assigning numeric values to textual survey responses to facilitate analysis and interpretation. Data were processed by sorting relevant responses, checking for errors, and ensuring completeness. All information was stored in a password-protected computer accessible only to the researcher. Data validation, outlier checks, and error correction were performed to prepare the dataset for analysis.

2.5 Data Analysis

The data analysis used in this study was path analysis, including mediation analysis, to examine the direct effects of self-concept, motivation, self-efficacy, and blended learning on the mathematics performance of STEM senior high school students in Basic Calculus, as well as the indirect effects of self-concept, motivation, and self-efficacy on their performance using blended learning as a mediating variable. Direct relationships among self-concept, motivation, self-efficacy, perceptions of blended learning, and mathematics performance were examined using correlational analysis. Descriptive statistics were calculated and reported using means and standard deviations to answer research problems 1, 2, 3, 4, and 5. Significant relationships were found between the students' mathematics performance and their self-concept, motivation, and self-efficacy, as measured using Pearson's correlation coefficient matrix. Path analysis was utilized to analyze the direct and indirect effects of self-concept, motivation, and self-efficacy on mathematics performance and blended learning experiences. Specifically, the mediating analysis investigated the mediating role of blended learning in the relationship between self-concept, motivation, and self-efficacy in mathematics performance. This mediation analysis employed a bootstrapping approach, generating 5,000 samples, with bias correction and 95% confidence intervals computed to determine the statistical significance of the indirect effects. All analyses were conducted using IBM SPSS Statistics 21.

2.6 Ethical Considerations

The researcher ensured that all ethical standards and protocols outlined by the University of St. La Salle-Bacolod City, about informed consent, confidentiality, and participant well-being, were followed. Approval to conduct the study was obtained from the University Research Ethics Review Committee, the school division superintendent, and the principals of the participating schools before data collection. The researcher provided the participants with information regarding the study's objectives, their rights, and confidentiality protocols. Leveraging the participants' experience, the researcher built trust with them and prioritized their emotional well-being throughout the study. Participants' identities were kept confidential through the use of codenames, and the names of the schools were excluded from the final paper to maintain anonymity. However, school administrations may request the final results. The researcher declares no commercial, financial, or institutional conflicts of interest. The study underwent thorough review by the research adviser, panel members, subject teachers, school heads, master teachers, and parent representatives. Research data were securely stored in computer storage devices with multiple backups for verification, reuse, or further investigation, and may be shared through journal publications or conference presentations. Unused physical and electronic files will be destroyed after a year, using appropriate disposal methods to maintain data security.

3.0 Results and Discussion

3.1 Mathematics Learning Performance Parameters

Table 1 presents the descriptive data on the learning performance parameters of Basic Calculus for STEM senior high school students, along with the independent and dependent variables. As presented in Table 1, STEM senior high school students demonstrated a high level of self-concept in Basic Calculus (M = 3.53, SD = 0.40), indicating a positive perception of their abilities in the subject. This supports Wang's (2023) findings that a strong self-concept has a direct and positive influence on learning performance, as students with a high self-concept tend to be more motivated, engaged, and challenged to excel. Similarly, the students demonstrated a high level of motivation (M = 3.55, SD = 0.37), aligning with Christian et al.'s (2020) recommendation to create a supportive learning environment that fosters academic motivation. This is further validated by Saadati et al. (2023), who noted that

highly motivated students actively participate in learning, are persistent, and demonstrate improved achievement in mathematics. In the same table, students also recorded a high level of self-efficacy (M = 3.45, SD = 0.36), reflecting confidence in performing calculus-related tasks. This is grounded in Bandura's (1997) Social Cognitive Theory, which posits that self-efficacy influences behavior and performance, particularly under challenging conditions.

Table 1. *Basic Calculus Learning Performance Parameters along with Independent and Dependent Variables*

Variables	Mean (M)	SD	Level
Self-Concept	3.53	0.40	High
Motivation	3.55	0.37	High
Self-Efficacy	3.45	0.36	High
Perceptions on blended learning instruction	3.50	0.38	Strongly favorable
Learning Performance	28.71	6.37	Moving towards mastery

In addition, the survey revealed that students had favorable perceptions of blended learning instruction in Basic Calculus (M = 3.50, SD = 0.38), consistent with Lu's (2021) findings that such environments promote critical thinking and cognitive engagement. Students appreciated the accessibility and flexibility of online materials, which allowed them to learn at their own pace and facilitated collaborative discussions through various tools and technologies. However, issues such as poor internet connectivity and power interruptions posed challenges, suggesting that the successful implementation of blended learning requires improved infrastructure. Lastly, Table 1 shows that students' learning performance in Basic Calculus, as indicated by their final exam results (M = 28.71, SD = 6.37), was approaching mastery. This aligns with the studies of Ceylan et al. (2017) and Negara et al. (2021), which confirmed the positive effects of blended learning on academic outcomes. The improvement can be attributed to students' active engagement in interactive activities, collaborative group work, and the integration of platforms like Google Classroom and GeoGebra, which made the learning process dynamic, accessible, and student-centered.

3.2 Relationships Between Identified Factors and Learning Performance

Self-concept and Learning Performance

Table 2 illustrates the correlation coefficient matrix between STEM students' self-concept and learning performance in Basic Calculus.

Table 2. *Correlation Coefficient Matrix Between Self-Concept and Learning Performance*

Variables	Mean±SD	df	*R*	p-value	Interpretation
Self-concept	3.53±0.40	218	.27*	< .001	Significant
Performance	28.71±6.37				

*Correlation is significant at the 0.05 level (2-tailed)

A Pearson correlation was used in Table 2 to determine if there is a significant relationship between the learning performance of STEM senior high school students in Basic Calculus and their self-concept. Preliminary analyses showed that the relationship was linear, both variables were normally distributed, and there were no outliers. A weak positive correlation was found between learning performance and self-concept, r (218) = .27, p < .001, with self-concept explaining 7.5% of the variance in learning performance. Given that the p-value is below the predetermined significance level of 0.05, the null hypothesis, which posits no significant relationship, is rejected. Consequently, it can be concluded that students' self-concept has a substantial impact on their learning performance in Basic Calculus. This outcome corroborates the findings of Arens et al. (2014) and Parker et al. (2018), who noted that mathematics self-concept—reflecting students' perception of their ability in mathematics—is positively related to competence in learning and academic achievement. Hence, it is essential to incorporate activities and strategies into the senior high school mathematics curriculum to boost students' self-concept, which could lead to academic success and an enhanced learning experience in Basic Calculus.

Motivation and Learning Performance

Table 3 reflects the correlation coefficient matrix between STEM students' motivation and learning performance in Basic Calculus.

Table 3. *Correlation Coefficient Matrix Between Motivation and Learning Performance*

Variables	Mean±SD	df	*R*	p-value	Interpretation
Motivation	3.55±0.37	218	.11	< .097	Not Significant
Performance	28.71±6.37				

*Correlation is significant at the 0.05 level (2-tailed)

A Pearson correlation was used in Table 3 to determine if there is a significant relationship between the learning performance of STEM senior high school students in Basic Calculus and their motivation. Preliminary analyses showed that the relationship was linear, both variables were normally distributed, and there were no outliers. A weak positive correlation was found between learning performance and motivation, r (218) = .11, p = .097, with motivation explaining 1.25% of the variance in learning performance. The null hypothesis was rejected since the obtained p-value was less than the established significance level ($p < 0.05$). This result supports the hypothesis that motivation does not significantly influence the learning performance of STEM senior high school students in Basic Calculus. This finding aligns with the results of Hoban et al. (2004) and Umairi et al. (2024), who noted that educators can still teach effectively even when students lack motivation.

Self-efficacy and Learning Performance

Table 4 shows the correlation coefficient matrix between STEM students' self-efficacy and learning performance in Basic Calculus.

Table 4. *Correlation Coefficient Matrix Between Self-Efficacy and Learning Performance*

Variables	Mean±SD	df	*R*	p-value	Interpretation
Self-efficacy	3.45±0.36	218	.19**	.005 *	Significant
Performance	28.71±6.37				

*Correlation is significant at the 0.05 level (2-tailed)

A Pearson correlation was used in Table 4 to determine if there is a significant relationship between the performance of senior high school students in Basic Calculus and their self-efficacy. Preliminary analyses showed that the relationship was linear, both variables were normally distributed, and there were no outliers. A significant but weak positive correlation was found between self-efficacy and performance, r (218) = .19, p = .005. The obtained p-value of .005 is less than the assigned significance level of p = .05, suggesting that individuals with higher self-efficacy tend to exhibit slightly better performance. However, the weak correlation indicates that the relationship is not particularly strong and that other factors likely contribute substantially to performance. While statistically significant, the correlation suggests that self-efficacy accounts for only 3.65% of the variability in performance. This result supports the findings of Sharm et al. (2004) and Saks (2024), who assert that self-efficacy has a significant impact on academic success, as students with high self-efficacy perceive challenges in complex tasks and projects as opportunities for growth and mastery. When faced with failures or difficult situations, they persist until success is achieved.

Students' Perceptions on Blended Learning and Learning Performance

Table 5 presents the correlation coefficient matrix between STEM students' perceptions of blended learning and their learning performance in introductory calculus.

Table 5. *Correlation Coefficient Matrix: Students' Perceptions on Blended Learning and their Learning Performance*

Variables	Mean±SD	df	*R*	p-value	Interpretation
Perceptions on Blended Learning	3.50±0.38	218	.30	< .001 *	Significant
Performance	28.71±6.37				

*Correlation is significant at the 0.05 level (2-tailed)

A Pearson correlation was used in Table 5 to determine if there is a significant relationship between the performance of senior high school students in Basic Calculus and their perceptions of blended learning experiences. Preliminary analyses showed that the relationship was linear, both variables were normally distributed, and there were no outliers. The results revealed a statistically significant, moderate positive correlation between perceptions of blended learning and performance, r (218) = .30, $p < .001$. This finding indicates that individuals with more positive perceptions of blended learning tend to demonstrate higher performance levels. This result supports Lu's (2021) findings that students who generally held positive perceptions of the blended learning environment experienced improved critical thinking skills in various areas, contributing to better learning outcomes. Heightened perceptions and awareness of the benefits of blended learning instruction can help make the learning process more adaptive and responsive, ultimately facilitating a more effective and enriching educational experience for all involved.

3.3 Path Analysis of Blended Learning Between the Identified Factors

Effects of the Identified Factors on Blended Learning Experiences and Mathematics Performance

Table 6 presents the direct and indirect path coefficients of the independent variables — self-concept, motivation,

and self-efficacy —on blended learning experiences and the performance of Basic Calculus mathematics by STEM senior high school students.

Table 6. *Effects of the Identified Factors on Performance and Blended Learning Experiences*

Path Coefficients	Estimate	Std. Error	z-value	p-value	95% Confidence Interval	
					Lower	Upper
Self-concept → Performance	.234	0.99	3.787	< .001**	0.10	0.35
Motivation → Performance	.092	1.05	1.498	.134	-0.02	0.20
Self-efficacy → Performance	.138	1.10	2.218	.027**	-0.00	0.27
Self-concept → Blended Learning	.105	0.06	1.575	.115	-0.04	0.26
Motivation → Blended Learning	- .009	0.07	-0.140	.889	-0.15	0.14
Self-efficacy → Blended Learning	.124	0.07	1.849	.064	0.00	0.25
Blended learning → Performance	.257	1.10	4.129	< .001**	0.13	0.38

**significant at 0.05 level

Table 6 reveals that self-concept has a significant positive direct effect on performance (β = 0.23, p < 0.001), suggesting that students with higher self-concept tend to perform better, regardless of their participation in a blended learning program. This aligns with the findings of Alkhateeb et al. (2022) and Ebrahim et al. (2024), who emphasized the significant relationship between academic self-concept and academic achievement across age and gender. However, self-concept did not significantly affect blended learning (β = 0.11, p = 0.115), indicating that it may not directly influence student engagement in this instructional model. This supports the findings of Suwendra et al. (2023), who noted that although students in a self-concept-based Upanishad blended learning model showed gains in character and creative thinking, the improvements were not statistically significant (p = .200 > .05).

Similarly, motivation had a positive yet non-significant direct effect on performance (β = .09, p = .130), implying that while motivated students may perform better, the relationship is weak. This result is consistent with Kusurkar (2013), who suggested that autonomous motivation enhances study strategies and effort, potentially increasing performance, albeit not significantly in this case. Motivation also showed no direct effect on blended learning engagement (β = -0.01, p = 0.889), which supports Brandt's (2022) conclusion that student motivation does not significantly impact content learning in a blended learning environment. In contrast, self-efficacy had a significant positive effect on performance (β = .14, p = .027), which aligns with Saks (2024), who demonstrated the predictive role of self-efficacy in students' goal-setting and learning outcomes. However, its effect on blended learning was insignificant (β = 0.12, p = 0.064), similar to Calyawa et al. (2023), who found high self-efficacy among teachers but no significant relationship with their teaching competence.

Lastly, blended learning showed a significant positive direct effect on performance (β = .26, p < .001), indicating that students engaged in blended learning tend to achieve higher. This supports the study of Indrapangastuti et al. (2021), who found that blended learning is more effective than traditional methods in helping students grasp mathematical concepts in Basic Calculus. Using a bootstrapping process, the study also examined the mediating role of blended learning in the relationship between self-concept, motivation, self-efficacy, and performance. This involved generating 5,000 samples and calculating the mean indirect effect, with bias correction and 95% confidence intervals to assess the statistical significance of the mediation paths.

3.4 Mediation Analysis Summary

Table 7 presents the indirect, direct, and total effects of the identified factors on mathematics performance and blended learning experiences.

Table 7. *Effects of the Identified Factors on Performance and Blended Learning Experiences*

Path Coefficients	Indirect Effect	Direct Effect	Total Effect	95% Confidence Interval		Conclusion
				Lower	Upper	
Self-concept → blended learning → performance	.234***	.027	.261***	- .008	.082	No Mediation
Motivation → blended learning → performance	.092	- .002	.090	- .047	.034	No Mediation
Self-efficacy → blended learning → performance	.138*	.032*	.169*	6.848×10^{-4}	.070	No Mediation

**p < .05, **p < .01, ***p < .001

Table 7 reveals that while self-concept and self-efficacy were found to have a direct and significant positive impact on performance, blended learning did not serve as an essential mediator in this relationship. This outcome suggests that self-concept and self-efficacy primarily influence performance directly rather than indirectly through blended learning. In contrast, motivation demonstrated a weaker or non-existent direct effect on performance and

did not appear to be significantly mediated by blended learning. Although blended learning may offer advantages such as increased accessibility and flexibility, the findings suggest that its effectiveness in mediating the relationships between self-concept, motivation, and self-efficacy on performance might be limited. Several studies have recently been conducted, such as those by Gheysar et al. (2024) and Shoukat et al. (2024), demonstrating the effectiveness of blended learning instruction in improving learning outcomes. However, there are still no studies investigating the efficacy of blended learning as a mediating variable between psychological factors and mathematics performance of senior high school students. Factors that need to be explored include the quality of the blended learning program, its implementation strategies, and individual student characteristics that may play a more crucial role in determining its overall impact as a mediator.

4.0 Conclusion

This study highlighted that self-concept, self-efficacy, and blended learning significantly influenced the mathematics performance of STEM senior high school students in Basic Calculus. Students with high self-concept and self-efficacy tend to show greater interest, confidence, and belief in their abilities, which contributes to better performance. However, although present at high levels, motivation did not show a significant direct or mediated effect on performance. This suggested the need for further investigation into how motivation affected learning outcomes in blended environments. Teachers needed continued support and training in pedagogical strategies and educational technology to maximize the potential of blended learning. Future research could explore teachers' perspectives and examine the influence of variables such as gender, socioeconomic status, and diverse learning abilities to understand better how blended learning can be tailored to support various learners effectively. Blended learning also directly enhanced performance, as students appreciated its flexibility and interaction, allowing them to learn at their own pace using multiple technology tools. Although blended learning did not significantly mediate the relationship between self-concept, motivation, and self-efficacy with performance, its direct contribution to academic success remained evident. Therefore, this study advocates for incorporating blended learning into the secondary mathematics curriculum and urges policymakers and educators to consider adopting this model to enhance educational outcomes.

5.0 Contribution of Authors

Author 1: conceptualization, proposal, and manuscript writing, data gathering, data analysis.
Author 2: conceptualization, advising, data analysis.

6.0 Funding

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7.0 Conflict of Interest

Both authors declare that they have no conflict of interest.

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