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Learning Strategies, Environment, and Mathematics Performance of the Students: A Regression Analysis

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Abstract. This descriptive-correlational study examined the learning strategies, learning environment, and mathematics performance of 102 randomly chosen first-year students from selected teacher education programs at a state university in Negros Occidental. Using a validated 58-item questionnaire, data were gathered to assess variables such as students' visual, auditory, read/write, and kinesthetic (VARK) learning strategies, alongside their adaptability to their learning environment. Statistical analyses included mean and standard deviation calculations, with Independent Samples t-tests, One-Way ANOVA, and Pearson's r for normally distributed data, and Mann-Whitney U-test and Spearman's rho for non-normally distributed data. Multiple regression analysis was also employed to determine predictive relationships. Findings revealed high levels of learning strategies, adaptability in the learning environment, and overall mathematics performance among the students. Group comparisons showed significant differences in learning strategies across visual, auditory, read/write, and kinesthetic modalities. In the learning environment, adaptability, no significant difference was observed by school of origin, while a significant difference was noted by program. Mathematics performance showed no significant difference by school of origin but differed significantly by program. Meanwhile, a moderate positive correlation was found between students' learning strategies and their mathematics performance, while a slight positive correlation was found between the learning environment and mathematics performance. Importantly, students' learning strategies statistically significantly predicted their mathematics performance. This implies that the approach the students take to learn has a significant impact on their mathematics outcomes. The study suggests that varied learning strategies also provide varied results in their performance in mathematics, implying that this factor, supported by the learning environment, plays a vital role in enhancing academic success in mathematics.

Keywords: Learning environment; Learning strategies; Mathematics performance; VARK.

1.0 Introduction

A learning strategy is a student's method of organizing and applying a particular set of skills to learn, understand, or accomplish various assignments with excellent success in academic as well as non-academic environments (Main, 2023). Learning strategies are essential catalysts of students' learning (Saqr et al., 2023). The VARK is a learning preference assessment tool designed to help individuals identify their preferred learning style, based on the four categories (Fleming, 1995, as cited in Tomic et al., 2023). The learning environment is also one of the factors that affects students' academic performance at school. It is essential to create an environment where students can comfortably learn and develop their needs and characteristics, as highlighted by Matheas (2017). Further, it emphasizes the importance of providing students with a conducive learning environment. The significance of the learning environment was contextualized in the study of Abubakar et al. (2015), conducted in one of the countries in Asia, which found that students who attend schools with sufficient resources, qualified instructors, and an encouraging atmosphere outperform those who attend schools with inadequate resources, unqualified teachers, and unfavorable environments. These findings lead to the study of Abalde and Oco (2023), which notes that students find mathematics difficult, making effective learning strategies and environments crucial. This may be related to students' perceptions of mathematics or how their learning practices influence academic achievement. Mathematics plays a vital role in various modern-world applications, including economics, building development, marketing, and personnel appraisal. Mathematics has significantly contributed to the development of the fast-paced lifestyle and its luxuries.

Studies have proven that learning strategies significantly impact student performance. According to Al-Seghayer (2021), learning strategies and academic success are closely tied to students' impressions of school. Research by Hakan (2020), Vet-eska et al. (2022), and Haataja et al. (2023) discovered a substantial relationship between learning strategies and academic achievement among university students. This study explores Visual, Auditory, Read/Write, and Kinesthetic strategies, known as VARK. Tomic et al. (2023) suggested that the VARK model can help determine secondary school students' preferred learning methods and optimize mathematical learning outcomes. Learning strategies and environment significantly impact students' academic performance. Recognizing their importance, this study investigates the relationship between learning strategies, environmental factors, and mathematics performance to improve student outcomes.

2.0 Methodology

2.1 Research Design

The researchers used a descriptive-correlational research design. A descriptive study design gives detailed and accurate information about a phenomenon, scenario, population, or subject's traits and actions (Sirisilla, 2023). It is also a research method used to describe the features of the population or phenomenon under investigation. This descriptive methodology focuses on the "what" of the research issue rather than the "why" (Bhat, 2023). A correlational research design, on the other hand, explores correlations between variables without the researcher altering or manipulating any of them (Bhandari, 2023). This research design was used to examine whether there is a relationship between learning strategies and students' mathematical performance, as well as between the learning environment and students' mathematical performance. Furthermore, the descriptive-correlational research design was used to determine the level of students' learning strategies, environment, and mathematics performance, as well as the relationship of students' learning strategies and environment to mathematics performance when grouped by high school of origin and program.

2.2 Respondents of the Study

The study was carried out in one of the state universities in Talisay City, Negros Occidental, Philippines. This study’s research area included first-year students from the College of Education, namely the Bachelor of Early Childhood Education (BECED), Bachelor of Elementary Education (BEED), and Bachelor of Special Needs Education (BSNED). These are the only programs enrolled in the course Mathematics in the Modern World during the study. The total population of students enrolled in the said programs is 102. The students were randomly selected through stratified proportionate random sampling to allocate the number of respondents from the different programs. G-power was used to determine the number of samples. Based on their programs, 27 students were from the Bachelor of Early Childhood Education, 48 were identified from the Bachelor of Elementary Education, and 27 were selected from the Bachelor of Special Needs Education.

2.3 Research Instrument

The research study about the learning strategies, environment, and mathematics performance of students utilized a researcher-made instrument questionnaire to gather information and data from the respondents. The research instrument was composed of three parts. The first part included the respondent's profile, including their email address, their name (optional), their test performance in Mathematics in the Modern World, their high school of origin, and their program. For the second part, the instrument contained a set of questions related to the level of learning strategies adopted by the students. It was classified into four parameters, namely, visual, auditory, read/write, and kinesthetic, consisting of 46 statements in assessing the level of learning strategies of the students. The third part of the instrument had 12 statements about the level of learning environment that students modify when studying. The researchers used a 5-point Likert scale and allowed the respondents to freely select their desired answer to the following questions: (5) strongly agree, (4) agree, (3) neutral, (2) disagree, and (1) strongly disagree. Proper and general instructions were attached to the instrument to guide the respondents in answering and rating each item.

The researchers asked nine (9) validators with Master's and Doctoral degrees in Mathematics to assess the questionnaire using Lawshe's Content Validation Instrument to establish the validity of the research instrument on the learning strategies and environment of students. The survey questionnaire's final copy was evaluated by the validators, and was also provided with a set of feedback and suggestions. The ratings given by the validators for each of the items were tallied, and CVR was calculated on each item to determine the validity of the items. Items with CVR greater than 0.75 were considered valid, on the visual strategy, 10 out of 15 statements were considered valid, on auditory and read/write strategy, 13 are valid out of 15 statements, on kinesthetic strategy, 10 out of 15 statements were considered valid, and on the learning environment of the students, 12 out of 15 statements were valid. The researchers used these sets of statements in their data collection. Furthermore, the researchers selected a total of 30 respondents from the programs intended by this research who were not part of the list of respondents of the study for reliability testing. The researchers then determined the value of Cronbach's alpha to establish the reliability of the survey instrument. Cronbach's value for the learning strategy of the students was indicated as follows: for the visual strategy was .904, the auditory strategy was .747, the read/write strategy was .937, and the kinesthetic strategy was .850. For the learning environment of the students, the Cronbach's value was .797.

2.4 Data Gathering Procedure

The researchers prepared a letter and secured consent from the Dean of the College of Education to conduct the study in one of the State Universities in Talisay City, Negros Occidental. After the researchers secured the approval of the Dean, they then reached out to the mayors of each section from the 1st year BECED, BEED, and BSNED programs. They sent them a letter requesting their classmates' participation in answering the questionnaire. To confirm their participation in the study, the researchers included a consent form on the first page, informing participants that participation was purely voluntary. The researchers included an explanation of the purpose of the survey, to help respondents understand the importance of their responses. Lastly, the researchers collected the data from the questionnaires, stored them, and tallied them for analysis and interpretation. After computing the results and forming conclusions, the researchers kept all private information gathered from the respondents. All information will soon be deleted, and physical copies of their responses will be stored with utmost confidentiality.

2.5 Data Analysis Procedure

The study employed various statistical tools to analyze the data based on the observed normality of distribution (see Appendix D). For Problems 1, 2, and 3, the mean and standard deviation were used to assess the levels of learning strategies (visual, auditory, read/write, and kinesthetic), the adaptability of the learning environment, and mathematics performance, both overall and when grouped by school of origin and program. For Problems 4, 5, and 6, independent sample t-tests and Mann-Whitney U tests were utilized to determine significant differences in learning strategies, adaptability of the learning environment, and mathematics performance when grouped by school of origin. At the same time, One-Way Analysis of Variance (ANOVA) was applied for comparisons by program. For Problem 7, Pearson's r measured the relationship between learning strategies and mathematics performance, while Spearman's rho analyzed the relationship between the learning environment and mathematics performance. Moreover, for Problem 8, multiple regression analysis was conducted to determine whether learning strategies and the learning environment significantly predicted mathematics performance. All analyses were performed using statistical software with a 5% significance level.

2.6 Ethical Considerations

To ensure that the respondents understand the goal of the study, the researchers made sure that the consent form was disseminated properly and the anonymity of the respondents was maintained and kept entirely confidential. After the data were gathered, the data gathering method was disposed of immediately and entirely without any backups or copies. The responses of the students were coded carefully and securely stored for 5 years, sealed in an envelope to ensure the confidentiality of the collected data, with exclusive access granted only to the researchers. After the storage retention period, the papers will be securely shredded to maintain the privacy and security of the information contained within.

3.0 Results and Discussion

3.1 Level of Learning Strategies of the Students

Results showed (see Table 1) that students demonstrated high learning strategy levels across visual (3.8±0.7), auditory (3.6±0.6), read/write (3.9±0.7), and kinesthetic (3.6±0.7) modalities. Public schools showed higher levels than private schools. Programs BEED and BSNED excelled in visual, auditory, and kinesthetic strategies. BECED had average levels across modalities. Students' effective learning strategies were consistent across schools and programs. This aligns with research (Khanal, 2016; Giordano, 2016) on distinct learning approaches. Effective learning strategies enhance academic success, tailored to specific programs and needs.

Table 1. *Level of Learning Strategies of the Students in terms of School of Origin and Program*

Grouping Variables	Visual			Auditory			Read/Write			Kinesthetic		
	Mean	VI	*SD*	Mean	VI	*SD*	Mean	VI	*SD*	Mean	VI	*SD*
A. As a whole	3.8	H	0.7	3.6	H	0.6	3.9	H	0.7	3.6	H	0.7
B. School of origin												
Public	3.9	H	0.7	3.7	H	0.6	4.0	H	0.7	3.7	H	0.7
Private	3.3	A	0.8	3.3	A	0.6	3.8	H	0.9	3.1	A	0.6
C. Programs												
BECED	3.4	A	0.9	3.3	A	0.8	3.7	H	0.9	3.4	A	0.9
BEED	4.0	H	0.6	3.8	H	0.5	4.2	H	0.6	3.7	H	0.6
BSNED	3.7	H	0.6	3.6	H	0.5	3.8	H	0.7	3.5	H	0.8

Note: Verbal Interpretation (VI); High (H); Average (A)

3.2 Level of Adaptability of the Learning Environment of the Students

Table 2 revealed high adaptability levels in students' learning environments (3.8±0.7). Consistent across schools and programs (BECED, BEED, BSNED), adaptability ranges from 3.6 to 4.0. This suggests students exhibit strong adaptability, actively adjusting to their learning environment. Research supports that high learning adaptability enables effective self-regulated learning, allowing students to adjust to changes, regulate their cognition, and modify their behavior for success (She et al., 2023).

Table 2. *Level of Adaptability of the Learning Environment of the Students in terms of School of Origin and Program*

Grouping Variable	Level of Learning Environment		
	Mean	Verbal Interpretation	Standard Deviation
A. As a whole	3.8	High	0.7
B. School of origin			
Public	3.8	High	0.7
Private	3.6	High	0.5
C. Programs			
BECED	3.6	High	0.7
BEED	4.0	High	0.6
BSNED	3.6	High	0.7

3.3 Level of Mathematics Performance of the Students

Table 3 showed that students demonstrated "high satisfactory" mathematics performance overall (84.8±3.6). Both public and private schools showed similar levels. In terms of programs, BEED students excelled, while BECED and BSNED students performed satisfactorily. These findings indicate students grasp mathematical concepts well, with BEED students standing out. Research suggests that mindset, study techniques, and passion for learning influence mathematical performance (Huang et al., 2020; Wong & Wong, 2019; Cleary & Kitsantas, 2017; Capuno et al., 2019).

Table 3. *Level of Mathematics Performance of the Students in terms of School of Origin and Program*

Grouping Variable	Mathematics Performance		
	Mean	Verbal Interpretation	Standard Deviation
A. As a whole	84.8	High Satisfactory	3.6
B. School of origin			
Public	84.6	High Satisfactory	3.6
Private	85.7	High Satisfactory	3.3
C. Programs			
BECED	83.9	Satisfactory	2.1
BEED	86.0	High Satisfactory	3.9
BSNED	83.6	Satisfactory	3.5

3.4 Difference in the Level of Learning Strategies in Terms of Visual, Auditory, Read/Write, and Kinesthetic Learning Styles of Students

Table 4 showed that there are significant differences in the level of learning strategies in terms of visual (U = 413.500, p = .009), auditory (U = 467.500, p = .022), and kinesthetic (U = 381.500, p = .002) of student between public and private school of origin while there is no significant difference in terms of read/write (U = 594.500, p = .250) of the students with their specified school of origin. The findings suggest that read/write learning strategies are widely utilized in both public and private schools, while visual, auditory, and kinesthetic strategies vary significantly depending on the school type, possibly due to differences in instructional approaches. Pashler et al. (2008) support this by showing that diverse educational backgrounds can enhance instructional effectiveness. However, Olsson (2009) argues that high school may not be the ideal stage to address varying learning strategies. Zain et al. (2019) found that low-achieving students favor read/write strategies, whereas high achievers prefer kinesthetic methods. Hussain (2017) emphasizes that students have unique learning needs, suggesting that teachers should tailor strategies to support individual learning effectively.

Table 4. *Mann-Whitney U Test Results for the Difference in the Level of Learning Strategies of Students according to their School of Origin*

Area	Grouping Variables	N	Mean of Ranks	Sum of Ranks	Mann-Whitney U			
					U-ratio	W	Z	p
Visual	Public	85	54.92	4668.50 584.50	431.500**	584.500	-2.618	.009
Auditory	Public	85	54.50	4632.50 620.50	467.500*	620.500	-2.296	.022
Read/Write	Public	85	53.01	4505.50 747.50	594.500	747.500	-1.151	.250
Kinesthetic	Public	85	55.51	4718.50 534.50	381.500**	534.50	-3.07	.002

Table 5 shows that there are significant differences in Visual Strategy (F (2,99) = 7.84, p = .001); Auditory Strategy (F(2,99) = 6.82, p = .002); Read/Write Strategy (F (2,99) = 5.27, p = .006) when grouped according to program. On the contrary, Kinesthetic Strategy (F (2,99) = 2.334, p = .102) has no significant difference when grouped according to program. The study shows that using visual, auditory, and read/write techniques differs significantly, with no connection to kinesthetic approaches. Chaudhry et al. (2020) critique the VARK model, stating it lacks reliability and overlooks factors like involvement and motivation, while focusing mainly on educators. Ishartono et al. (2021) found that visual, auditory, and kinesthetic learners are capable of higher-order thinking skills—analyzing, evaluating, and creating—though each has its weaknesses in these areas.

Table 5. *One-Way NOVA Results for the Difference in the Level of Learning Strategies of Students with their Programs*

Learning Strategies		Sum of Squares	df	Mean Squares	F-ratio	p
Visual	Between Groups	6.726	2	3.363	7.84**	.001
	Within Groups	42.447	99	.429		
Auditory	Between Groups	4.468	2	2.234	6.82**	0.002
	Within Groups	32.426	99	.328		
Read / Write	Between Groups	5.156	2	2.578	5.27**	0.007
	Within Groups	48.453	99	.489		
Kinesthetic	Between Groups	2.454	2	1.227	2.33	.102
	Within Groups	52.052	99	.526		

The results in Tables 6, 7, and 8 present the Post Hoc Analysis for the significant difference in learning strategies in terms of visual, auditory, and read/write of students according to their programs.

Table 6. *Post Hoc Analysis for the Significant Difference of the Level of Learning Strategy in terms of Visual of Students according to their Programs*

Visual		Mean Difference	p
Program (I)	Program (J)		
BECED	BEED	-.62222**	.000
	BSNED	-3.5556	.119
BEED	BSNED	.26667	.213

Table 6 shows the Post Hoc Analysis for the significant difference in the level of visual strategy of students according to their programs. There are no significant differences in the visual strategy of BECED and BSNED students (MD = -3.5556, p = .119), and BEED and BSNED students (MD = 2.6667, p = .213). On the other hand, there is a significant difference in the visual strategy of BECED and BEED students (MD = -.62222, p < .001). The findings indicate that BEED students are more likely to use visual learning strategies compared to BECED students, who use them less. Kamal et al. (2021) found that most students prefer a single learning mode, favoring visual strategies, although many also rely primarily on reading and writing. Instructors are encouraged to tailor teaching methods to student preferences, where specific learning strategies may align with career needs. However, Hussman and O'Loughlin (2018) argue that aligning study techniques with VARK learning styles has little impact on course outcomes, suggesting that both students and educators should critically view learning style theories.

Table 7 shows the Post Hoc Analysis for the significant difference in the Level of Auditory Strategy of students according to their programs. There are no significant differences in the Auditory Strategy of BECED and BSNED students (MD = .25556, p = .234), and BEED and BSNED students (MD = .24792, p = .175). However, there is a significant difference in the Auditory Strategy of BECED and BEED students (MD = -.50347, p < .001).

Table 7. *Post Hoc Analysis for the Significant Difference of the Level of Learning Strategy in terms of Auditory Perception of Students according to their Programs*

Auditory Strategy		**Mean Difference**	***p***
Program (I)	**Program (J)**		
BECED	BEED	-.50347**	.001
	BSNED	.25556	.234
BEED	BSNED	.24792	.175

The results indicate that students from the BEED program are more inclined to apply and use the auditory strategy compared to those from the BECED program. While the BEED and BSNED, as well as the BECED and PA BSNED, have similar or comparable levels of utilization. Learning films benefit children with auditory learning preferences by providing sound along with visual elements (Yalçinkaya et al., 2009, cited in Kusumawarti et al., 2020). Kayalar and Kayalar (2017) found that auditory learners effectively process information through reading, writing, and listening. However, if students struggle to interpret language sounds, it can hinder their development of written language skills, highlighting the interconnectedness of listening and writing exercises.

Table 8 shows the Post Hoc Analysis for the significant difference in the Level of Read/Write Strategy of students according to their programs. There are significant differences in the Read/Write Strategy of BECED and BEED students (MD = .168, p = .013), and BEED and BSNED students (MD = .168, p = .046). However, there is no significant difference in the Read/Write Strategy of BECED and BEED students (MD = .190, p = .904). According to the results, it implies that BECED students employ the read/write strategy compared to the other two programs, BEED and BSNED. Among the three (3) programs, students from the BSNED program are least likely to use the read/write strategy, while BEED students fall somewhere in between. Rogowsky et al. (2020) confirm that visual learners perform better with visual training, while auditory learners benefit more from aural training. Massa and Mayer (2006) also support this, suggesting that "visualizers" learn best visually and "verbalizers" benefit more from verbal instruction. However, Kumar et al. (2011) found that kinesthetic and read-write learners using deep learning strategies perform academically better than auditory and visual learners who employ surface learning approaches. Encouraging kinesthetic and read-write learners to prioritize these methods may enhance exam performance.

Table 8. *Post Hoc Analysis for the Significant Difference of the Level of Learning Strategy (Read/Write) of Students according to their Programs*

Read/Write Strategy		**Mean Difference**	***p***
Program (I)	**Program (J)**		
BECED	BEED	.16830*	.013
	BSNED	.19040	.904
BEED	BSNED	.16830*	.046

3.5 Difference in the Level of Adaptability of the Learning Environment of the Students

Table 9 shows that there is no significant difference in the level of adaptability of the learning environment of the students' school of origin (t(100) = 1.500, p = .15). In the study of Rahmasari et al. (2023), the findings about the relationship between learning environment and school origin indicate that there are no significant differences in students' learning environments according to their school origin or method of entrance to universities, indicating that all students benefit equally from improved learning environments.

Table 9. *t-test Results for the Difference in the Level of Adaptability of the Learning Environment of the Students' School of Origin*

	School of Origin	**Mean**	**Standard Deviation**	**df**	***t*-ratio**	***p***
Learning Environment	Public	3.8	.67	100	1.5	.15
	Private	3.6	.54			

Results showed in Table 10 that there is a significant difference in the level of adaptability in the learning environment of the first year college of education students (F (2,99) = 3.969, p = .022). This implies that the program that the students belong to has an impact on their level of adaptability in their learning environment.

Table 10. *ANOVA Results in the Level of Adaptability of the Learning Environment of First Year College of Education Students according to Program*

	Sum of Square	df	Mean Square	*F*-ratio	*p*
Between Groups	3.187	2	1.594	3.969*	.022
Within Groups	39.747	99	.401		
Total	42.934	101			

The results in Table 11 present the Post Hoc Analysis for the significant difference in the level of adaptability of the learning environment of the students according to their programs. Table 11 shows that there are significant differences in BECED and BEED (MD = -.38264, p = .036), while there is no significant difference in both BECED and BSNED (MD = -.06296, p = .929), and BEED and BSNED (MD = .31968, p = .096). Results found that there is a significant difference in adaptability to the learning environment between BECED and BEED programs, but no difference between BECED/BSNED or BEED/BSNED. This suggests that BECED and BEED programs uniquely impact students' adaptability. According to Hendrix (2019) and Aquino (2019), research shows that the learning environment significantly impacts students' adaptability, academic success, motivation, and engagement. Variables like seating, lighting, noise, and color influence learning capacity. Positive learning environments enhance student outcomes, particularly in institutions like the College of Education programs.

Table 11. *Post Hoc Analysis for the Significant Difference in the Level of Adaptability of the Learning Environment According to Program*

Program (I)	Program (J)	Mean Difference (I-J)	*p*
BECED	BEED	-.38264*	.036
	BSNED	-.06296	.929
BEED	BSNED	.31968	.096

3.6 Difference in the Level of Mathematics Performance of the Students

Table 12 shows that there is no significant difference in the level of Mathematics Performance of first-year college of education students when grouped according to their school of origin (t(100) = -1.155, p = .251). It implies that the students have the same level of mathematics performance regardless of the type of school they attended. A study by Alojado et al. (2023) found no significant difference in math performance based on students' original school, recommending teachers use regular formative assessments and close monitoring through in-person and online discussions to support math development.

Table 12. *t-Test Results in the Level of Mathematics Performance of the Students according to School of Origin*

	School of Origin	Mean	Standard Deviation	df	*t*-ratio	*p*
Mathematics Performance	Public	84.612	3.6158	100	-1.155	.251
	Private	85.706	3.2933			

Table 13 shows that there is a significant difference in the level of mathematics performance of the students when grouped according to their program (F (2,99) = 5.71, p = .004). The result shows that students in the three programs differ significantly in their mathematics performance.

Table 13. *ANOVA Results in the Level of Mathematics Performance of the Students according to Program*

	Sum of Squares	df	Mean Square	*F*-ratio	*p*
Between Groups	133.343	2	66.672	5.71*	.004
Within Groups	1155.333	99	11.670		
Total	1288.676	101			

The results in Table 14 present the Post Hoc Analysis for the significant difference in the level of mathematics performance of the students according to their program.

Table 14. *Post Hoc Analysis for the Significant Difference in the Level of Mathematics Performance according to Program*

Program (I)	Program (J)	Mean Difference (I-J)	*p*
BECED	BEED	-2.11111*	.031
	BSNED	.33333	.932
BEED	BSNED	2.44444*	.010

Table 14 shows the Post Hoc analysis of the level of mathematics performance of the students according to their program. It shows that there are significant differences in BECED and BEED (MD = -2.11, p = .031), and in BEED and BSNED (MD = 2.44*, p = .010), while there is no significant difference in both BECED and BSNED (MD = .33, p = .932). It implies that the mathematics performance of the BEED students is higher than that of the BECED and BSNED students. This suggests that BEED students perform better in mathematics than the other two programs.

Research studies, including Pendon's (2022) and Dela Rosa and Nicasio's (2021), support the findings, indicating significant differences in math performance among students in various programs, with self-efficacy positively correlating with math skills, and specific programs, like BEED, excelling in math competency.

3.7 Relationship Between the Learning Strategies and Mathematics Performance of the Students

Table 15 shows that there is a significant relationship between the learning strategies and the mathematics performance of the students (r = 0.379, p <.001). This implies that there is a moderate positive relationship between the learning strategies and the mathematics performance of the students. This means that a higher level of learning strategy is associated with higher mathematics performance among students. Research by Adu et al. (2020) and Abidin et al. (2011) confirms that various learning strategies positively impact students' math achievement, with students employing multiple strategies showing higher academic performance, underscoring the significant influence of learning strategies on overall student success.

Table 15. *Relationship Between the Learning Strategies and Mathematics Performance of the Students using Pearson's r*

Variables	*r*-ratio	*p*
Learning Strategies and Mathematics Performance	.379**	<.001

Table 16 shows that there is a significant relationship between the learning environment and mathematics performance of the students (r = .250, p = .011). This implies that there is a small positive relationship between the learning environment and the mathematics performance of the students. This means that there is a possibility that the higher the level of adaptability of the learning environment of the students, the higher their mathematics performance. According to Shamaki (2015), a well-ventilated, well-lit, and temperature-controlled learning environment significantly enhances students' math performance, emphasizing the importance of optimal classroom conditions for academic achievement.

Table 16. *Relationship Between the Learning Environment and Mathematics Performance of the Students using Spearman's Rank-Order Correlation Coefficient*

Variables	Rho, ρ	*p*
Learning Strategies and Mathematics Performance	.250*	.011

3.8 Learning Strategies and Environment Predict the Mathematics Performance of the Students

Table 17 shows a multiple regression of learning strategies and learning environment as predictors of the mathematics performance of the students. There was linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values. Residuals were independent, as assessed by Durbin - Watson statistic of 1.86; homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values; no evidence of multicollinearity, as assessed by tolerance values greater than 0.1; no studentized deleted residuals greater than ±3 standard deviations, no leverage values greater than 0.2, and values for Cook's distance above 1. The assumption of normality was met, as assessed by a Q-Q Plot. However, learning strategies reflected p-values greater than 0.05; thus, this variable was excluded from the model. The prediction equation was Mathematics Performance = 76.242 + 1.901*Learning Strategies. The regression model statistically significantly predicted mathematics performance for students with F(2,99) = 8.4, p < .001, accounting for 14.5% of the variation in the mathematics performance with adjusted R^2 = 12.8%, a partial substantial size effect according to Cohen (1988).

Table 17. *Multiple Regression Results for Learning Strategies and Learning Environments as Predictors of Mathematics Performance of the Students*

Mathematics Performance	*B*	95% CI for B		SE *B*	β	R^2	ΔR^2
		LL	UL				
Model						0.145	0.128
Constant	76.24**	72.03	80.46	2.13			
Learning Environment	0.39	-1.30	2.07	0.85	0.071		
Learning Strategies	1.90*	0.88	3.71	0.91	0.32		

Note: Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; CI = confidence interval; *LL* = lower limit; *UL* = upper limit; SE *B* = standard error of the coefficient; ß = standardized coefficient; R^2 = coefficient of determination; ΔR^2 = adjusted R^2. *p < 0.05, **p < 0.01, ***p < 0.001

This implies that the mathematics performance of the students may vary depending on their learning strategy, but not on their level of adaptability to the learning environment. The result of the study indicated that the mathematics performance of the students is significantly influenced by their adapted learning PA strategies. This finding is supported by the study of Igwe and Iweka (2020). The study showed that learners' academic success is significantly predicted by their learning strategies. Silangan et al. (2023) also found that the students' home and school environment, which are also part of their learning environment, are not significant predictors of their mathematics performance.

4.0 Conclusion

Based on the findings of the study, the following conclusions were drawn.

1. The results implied that the students have very effective learning strategies in terms of the VARK they possess for their education and learning process, which means students have highly effective strategies for studying and support their education effectively. This suggests that students have a high ability to engage with diverse learning strategies and still have a high mathematics performance.
2. The results revealed that students, by their school of origin and enrolled programs, are highly adaptive to their learning environment. This indicates that the educational institution should support and effectively develop an environment conducive to the development and diverse learning strategies of the students, which enhances the students' overall schooling and learning experiences. The results also imply that students can adapt easily in their learning environment, encompassing both their school of origin (public or private) and various programs like BECED, BEED, and BSNED. This adaptability underscores their ability to thrive in different educational environments.
3. These findings imply that students from both public and private schools, and BEED students, grasp mathematical concepts very well and reflect their understanding in their assessments with high results. On the other hand, BECED and BSNED students meet the expected standards set for mathematics proficiency. This also describes that the assessment results of these students are at the average level.
4. The study reveals that while read/write strategies are widely used in public and private schools, visual, auditory, and kinesthetic strategies vary across schools. The BEED program has a more adaptable visual strategy, while BECED students are less likely to use visual aids. The BEED and BSNED programs have similar levels of utilization, but BECED students use the read/write strategy more. The BSNED program has the least use of the read/write strategy, while BEED students fall somewhere in between.
5. These findings imply that students in the BECED and BEED programs differ significantly in their ability to adapt to the learning environment. However, there are no significant differences between BECED and BSNED, or BEED and BSNED, indicating that students in those programs show comparable levels of adaptability. This shows that the BECED and BEED programs may significantly impact students' capacity to adapt to their learning environment.
6. The findings implied that the students have the same level of mathematics performance regardless of the type of school they attended. On the other hand, when students are grouped according to program (BECED, BEED, BSNED), the results indicate that the mathematics performance of the BEED students is higher than that of the BECED and BSNED students. This suggests that BEED students perform better in mathematics than the other two programs.
7. The results implied that the better the learning strategy, and the higher the level of adaptability of the learning environment of the students, the higher the mathematics performance is. This means that when students use a learning strategy that works best for them, and a learning environment where they can function well, they would most likely produce better performance in mathematics.
8. The results indicated that the learning strategies of the students predict their mathematics performance, but not their learning environment. This means that the learning strategy that the student uses in learning is most likely linked to their performance in mathematics. In contrast, the learning environment of the students, which includes the classrooms, learning centers, and availability of resources, does not appear to influence their mathematics performance directly.

5.0 Contributions of Authors

Julia B. Suala: Statistical data analysis using SPSS, manuscript writing, development of research instruments, methodology, data gathering and analysis, and revision of the final manuscript.
AJ J. Lagarto: Conceptualization of the research title, manuscript writing, development of research instruments, methodology, data gathering and analysis, and revision of the final manuscript.
Jessa May H. Tico: Manuscript writing, development of research instruments, methodology, data gathering and analysis, and revision of the final manuscript.
Dave B. Echenique: Statistical data analysis using SPSS, manuscript writing, methodology, and revision of the final manuscript.
Dr. Jomeo Sumalapao: Research advising and revision of the final manuscript.

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7.0 Conflict of Interests

There is no conflict of interest to declare.

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