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Self-Efficacy and Student Persistence as Predictors of Mathematics Engagement Among Grade 8 Learners: A Forecasting Analysis

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Abstract — Low engagement in mathematics is persisting. Mathematics engagement was forecasted using self-efficacy and student persistence as predictors. Through predictive study design, and multiple linear regression analysis, the data from 184 learners selected through stratified ramdom sampling revealed that mathematics engagement is strongly and significantly forecasted by the predictors, partly affirming Expectancy-Value Theory. Future research may explore additional variables to explain the remaining variance in the strength of the predictive model, with exploratory studies helping identify new potential factors. Educators and curriculum developers may implement strategies that strengthen learner persistence and self-efficacy to enhance mathematics engagement.

Keywords: ***Self-efficacy , student persistence, predictors of mathematics engagement, grade 8 learners, forecasting analysis***

I. INTRODUCTION

Poor engagement in mathematics remains a significant educational concern, as many students demonstrate low levels of interest and active involvement in mathematics learning activities. Learners worldwide show low engagement in mathematics, with many failing to achieve expected levels of participation and sustained interest (IEA,2023). Furthermore, international

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research highlights that insufficient engagement in mathematics continues to be observed among students during learning activities (Dale H. Schunk & Frank C. DiBenedetto, 2023).

In countries such as the United States, China, and Australia, international assessments reveal that a significant number of middle school students demonstrate limited involvement in mathematics tasks. Only a fraction achieve proficiency in problem-solving and conceptual understanding, highlighting the widespread nature of this issue across diverse educational systems (IEA, 2023). Studies indicate that learners consistently exhibit limited engagement in mathematics tasks across different educational contexts (Jacquelynne Eccles & Allan Wigfield, 2023).

Filipino students face similar situation of poor engagement in mathematics. Many students in public schools display minimal interaction with mathematical content (IEA, 2023). In regions like Cebu, classroom observations show disinterest and infrequent participation in mathematics activities among junior high school students. Evidence from large-scale assessments such as the Programme for International Student Assessment (PISA 2022 results) indicates that Filipino learners often show limited engagement in mathematics tasks, reflecting minimal interaction and participation during learning (Organisation for Economic Co-operation and Development, 2023).

The decline in mathematics engagement has significant implications for students academic success and future career readiness. Disengaged learners are more likely to develop mathematics anxiety and avoid STEM-related pathways, thereby limiting their opportunities in innovation-driven fields (Sian L. Beilock, 2023). Furthermore, poor engagement undermines the development of essential problem-solving and critical thinking skills required in the global workforce (World Bank, 2023). Despite growing attention to student engagement in mathematics, a notable research gap persists in exploring the predictive role of self-efficacy and student persistence among learners. Existing literature often focuses on general academic performance without delving into these specific psychological mechanisms or their interplay in shaping engagement. This study addresses this gap by investigating self-efficacy and students' persistence as predictors of mathematics engagement, among Grade 8 learners in the Philippines, aiming to inform targeted interventions for enhanced educational outcomes.

This study examined the predictive roles of self-efficacy and persistence in mathematics engagement among Grade 8 learners. It supports Sustainable Development Goal 4 (Quality

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Education) by emphasizing the importance of learners' confidence, perseverance, and active participation in Mathematics as foundations for meaningful and inclusive learning. The findings aim to show that learners with strong self-efficacy and persistence demonstrate higher levels of engagement in Mathematics, leading to sustained interest and improved learning outcomes. This study may benefit educators, school administrators, and curriculum developers by providing insights for designing strategies and interventions that strengthen learners' confidence and persistence in Mathematics. Furthermore, the findings may be beneficial to Holy Cross of Davao College by serving as a basis for enhancing instructional practices, improving student engagement programs, and supporting initiatives that promote effective Mathematics learning among Grade 8 learners. Additionally, this study may serve as a reference for future research on psychological predictors of academic engagement. This study is anchored on the Expectancy-Value Theory (EVT) of achievement motivation, initially proposed by Eccles and Wigfield (2002).

II. METHODOLOGY

This study employed a predictive research design which is a quantitative approach that aims to determine the extent to which one or more independent variables can predict an outcome variable through statistical analysis. It focuses on identifying patterns and relationships among variables to forecast future outcomes based on existing data (Gonzalez-Nucamendi et al., 2023). This design is commonly applied when researchers seek to estimate or predict behaviors, performance, or trends, particularly in educational studies where variables are used to predict student outcomes and engagement (Pacheco-Mendoza et al., 2023). One of its main advantages is its ability to identify significant predictors and support data-driven decision-making, allowing researchers to develop models that improve accuracy in forecasting results and guiding interventions (Almalawi, 2024). Additionally, predictive research design enables the testing of theoretical models and provides practical insights for improving educational practices and outcomes through evidence-based predictions (Bitew, 2024).

The study was conducted in a public secondary school within the Department of Education Division of Sarangani Province, Region XII,. The selected school implements learner-centered approaches and is characterized by efforts to enhance student participation and engagement

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through diverse instructional strategies. According to DepEd (2020), Philippine public schools are mandated to promote inclusive and engaging teaching practices that improve student learning outcomes and motivation. The location was appropriate for investigating mathematics engagement because of its diverse student population, which provides a representative context for studying self-efficacy and persistence among Grade 8 learners (Mullis *et al.*, 2020; OECD, 2019).

A total of 184 Grade 8 learners were selected from a population of 350 students enrolled in the chosen public secondary school. The sample size was determined using the Raosoft sample size calculator with a 95% confidence level, 5% margin of error, and 50% response distribution, ensuring representativeness and statistical reliability (Etikan & Bala, 2017). Stratified random sampling was employed to achieve proportional representation across gender and class sections. In stratified sampling, the population is divided into distinct subgroups (strata) based on key characteristics, and samples are proportionally selected to reflect the composition of the population. This technique enhances generalizability and reduces sampling bias (Fraenkel, Wallen, & Hyun, 2020). Only learners aged 13–15 were included to ensure developmental and academic consistency within the sample (Schunk & DiBenedetto, 2020).

This study utilized the survey technique as the primary method of data collection. A survey technique is a quantitative data-gathering method that involves collecting information from respondents through structured questionnaires to measure variables such as attitudes, perceptions, and behaviors (Siedlecki, 2023). It is commonly applied when researchers aim to obtain standardized data from a large group of participants in a systematic and efficient manner, particularly in educational research where learners' psychological and behavioral factors are being examined (Story & Tait, 2023). The use of a survey technique is appropriate for this study as it allows for the collection of data on self-efficacy, persistence, and mathematics engagement among Grade 8 learners. One of its key advantages is its ability to gather large amounts of data within a short period while ensuring consistency in responses due to the use of structured instruments (Siedlecki, 2023). Additionally, survey techniques are cost-effective, easy to administer, and facilitate statistical analysis, making them suitable for identifying patterns and relationships among variables in predictive research (Story & Tait, 2023).

There were three adopted and modified questionnaires utilized in this study. The first instrument, the Self-Efficacy Questionnaire, assessed students' self-efficacy in mathematics

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learning. This questionnaire was adapted and modified from Asoy and Picaza (2021) to suit the context of Grade 8 learners. It consisted of 18 items covering four indicators: mastery experience**,** vicarious experience**,** social persuasion**,** and physiological state**.** Responses were recorded using a four-point Likert scale, with 4 indicating "Strongly Agree," 3 indicating "Agree," 2 indicating "Disagree," and 1 indicating "Strongly Disagree." The adapted instrument was pilot-tested for reliability, yeilding a Cronback's alpha of 0.953. The second instrument, the Persistence Questionnaire, measured students' persistence in mathematics. This instrument was adapted and modified from Asoy and Picaza (2021. It covered four areas: persistence in classroom activities, persistence in homework and assignments, persistence in group work, and persistence during mathematics examinations. The instrument consisted of 23 items, distributed across the four areas, and responses were recorded using a four-point Likert scale, with 4 indicating "Strongly Agree," 3 indicating "Agree," 2 indicating "Disagree," and 1 indicating "Strongly Disagree." The adapted instrument was pilot-tested for reliability, yeilding a Cronback's alpha of 0.952. The third instrument, the Mathematics Engagement Questionnaire, assessed students' engagement in mathematics learning. This questionnaire was adapted and modified from existing studies on student engagement, particularly Jennifer Fredricks et al. (2020. It consisted of 17 items organized under three indicators: behavioral engagement, emotional engagement, and cognitive engagement. Responses were recorded using a four-point Likert scale, with 4 indicating "Strongly Agree," 3 indicating "Agree," 2 indicating "Disagree," and 1 indicating "Strongly Disagree." The adapted instrument was pilot-tested for reliability, yeilding a Cronback's alpha of 0.952.

This study employed descriptive, correlational, and multiple linear regression analyses to examine the relationships among the variables. Descriptive analysis is a statistical method used to summarize and describe the characteristics of data through measures such as mean and standard deviation, providing a clear overview of the variables being studied (Siedlecki, 2023). It is applied when researchers aim to present the general trends or levels of variables within a dataset. Correlational analysis, on the other hand, is used to determine the strength and direction of the relationship between two or more variables, making it appropriate when examining associations among factors such as self-efficacy, persistence, and mathematics engagement. Pearson r was used as statistical treatment (Kaur et al., 2023). Regression analysis is a predictive statistical technique that assesses the extent to which one or more independent variables influence a dependent variable, allowing researchers to identify significant predictors and estimate their contribution to an

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outcome. The standardized and unstandardized beta coefficient were used as statistical treatment (Gonzalez-Nucamendi et al., 2023).

The interpretation of the descriptive level of variable is based on the following standard scheme :

Scale	Level	Self-efficacy	Student Persistence	Mathematics Engagement
1.00 – 1.74	Very Low	Very Weak	Very Weak	Very Weak
1.75 – 2.49	Low	Weak	Weak	Weak
2.50 – 3.74	High	Strong	Strong	Strong
3.75 – 4.00	Very High	Very Strong	Very Strong	Very Strong

The following is the Standard Deviation Value Ranges and Interpretations:

Ranges	Description	Interpretation
SD ≤ 0.50	High Consistent Responses	Strong and Uniform Perception
SD = 0.51 – 1.00	Moderate Consistent Responses	Acceptable Consistency
SD = 1.01 – 1.00	Low Consistent Responses	Differing views or experiences
SD > 1.50	Very Low Consistency Responses	High Variablity and lack of consensus

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For the interpretation scale of r-value, the following scheme as proposed by Guilford (1956)wasused:

Computed r	Descriptive Interpretation
±1.00	Perfect correlation
±0.75 – ±0.99	High correlation
±0.51 – ±0.74	Moderately high correlation
±0.31 – ±0.50	Moderately low correlation
±0.01 – ±0.30	Low correlation
0.00	No correlation

In terms of Scale of Beta (β) Coefficient Strength, the following scheme as proposed by Cohen (1988) and Hair et al. (2019) was used:

β Value Range	Strength of Relationship
±0.00 – ±0.09	Very Weak
±0.10 – ±0.29	Weak
±0.30 – ±0.49	Moderate
±0.50 – ±0.69	Strong
±0.70 and above	Very Strong

Informed consent from parents and school authorities, as well as student assent, were secured prior to participation, while anonymity and confidentiality were strictly maintained through the use of non-identifiable and aggregated data. Participants were informed of their right to withdraw at any time without consequences, and all data were securely handled in compliance with the Data Privacy Act of 2012, ensuring that their rights and welfare were fully protected throughout the study. How is confidentiality is undertaken? This study adhered to the ethical protocols of the Holy Cross of Davao College Society for Moral Integrity and Legal Ethics (HCDC-SMILE) to ensure the protection and well-being of the learners, with measures in place to minimize risks such as stress or confidentiality breaches.

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III. RESULTS AND DISCUSSIONS

Table 1 is descriptive table. It contains the variables included in the study namely self-efficacy , persistence , and student engagement in mathematics with their respective indicators**.** It also contains the number of samples, standard deviation (SD), mean scores, and the descriptive level of each variable and its sub-dimensions.

TABLE 1
DESCRIPTIVE ANALYSIS

Variables	N	SD	Mean	Descriptive Level
Self-Efficacy in Mathematics (IV_1)	***184***	***0.39***	***2.96***	***High***
Mastery Experience		0.50	2.69	High
Vicarious Experience		0.51	2.97	High
Social Persuasions		0.52	3.08	High
Physiological State		0.41	3.10	High
Persistence in Mathematics (IV_2)	***184***	***0.41***	***2.94***	***High***
Persistence in Classroom Activities		0.43	2.97	High
Persistence in Homework and Assignments		0.48	2.79	High
Persistence in Group Work		0.46	2.96	High
Persistence During Math Examination		0.52	3.02	High
Student Engagement in Mathematics (DV)	***184***	***0.41***	***2.87***	***High***
Behavioral Engagement		0.43	2.95	High
Emotional Engagement		0.52	2.81	High
Cognitive Engagement		0.44	2.85	High

Very High - (3.26 – 4.00); High - (2.50 – 3.25); Low – (1.75 – 2.49); Very Low – (1.00 – 1.74)

Specifically, the table shows that self efficacy variable obtains a mean of 2.96, described as high. This indicates that the self-efficacy in mathematics is strong. All its indicators are described as high. The corresponding standard deviation of 0.39, described as high consistent responses, is indicating strong and uniform perception. Moreover , the table shows that persistence

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obtain a mean of 2.94, described as high. It also indicates that the persistence in mathematics learnings is strong. All its indicators are described as high. The corresponding standard deviation of 0.41, described as high consistent responses, is indicating strong and uniform perception.

Furthermore, it also shows that student engagement in mathematics obtains a mean of 2.87, described as high. It also indicates that the engagement in mathematics learnings is strong. All its indicators are described as high. The corresponding standard deviation of 0.41 described as high consistent responses, is indicating strong and uniform perception.

Self-efficacy, persistence, and student engagement in mathematics are all described as high, indicating that learners demonstrate strong confidence, sustained effort, and active involvement in their learning. Comparatively, while all variables reflect similarly strong and consistent perceptions, self-efficacy and persistence appear slightly more pronounced, suggesting they may play a more influential role in supporting students' engagement in mathematics.

Table 2 is correlation table. It presents predictive variables and criterion variables. It shows the r-value, p-value, decision on null hypothesis and the corresponding interpretation.

TABLE 2
CORRELATION ANALYSIS

	Student Engagement in Mathematics (DV)				
	N	**r**	**p-value**	**Decision on Ho @ 0.05 level of significance**	**Interpretation**
Self-Efficacy in Mathematics (IV_1)	184	0.723	0.000	Reject Ho	Significant Strong Positive Correlation
Persistence in Mathematics (IV_2)	184	0.859	0.000	Reject Ho	Significant Very Strong Positive Correlation

The table specifically shows that the correlation between self-efficacy and student engagement in mathematics obtained a p-value of 0.000, which is less than 0.05 degree of confidence hence the null hyphothesis was rejected. It indicates that the correlation is significant

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strong positive correlation. The r-value of 0.723, reflects a moderately high correlation. This implies that when self-efficacy is nortured , students are more likely to engage in mathematics .

Similarly, the correlation between persistence and student engagement in mathematics obtained a p-value of 0.000 which is less than 0.05 degree of confidence hence the null hyphothesis is rejected. It indicates that the correlation is significantly very strong positive correlation. The r value of 0.859 reflects a high correlation. This implies that students who persist are highly engaged in mathematics learning.

Both self-efficacy and persistence show significant positive relationships with student engagement in mathematics, indicating that higher levels of confidence and sustained effort are associated with greater engagement. Comparatively, persistence demonstrates a stronger relationship with engagement than self-efficacy, suggesting it may have a more influential role in driving students' active involvement in mathematics learning.

Regression Analysis

Table 3 is the regression table. It contains the predictive and the criterion variables. It also contains the unstandardized beta coeficient, the standard error, the standard beta coefficient, the t-value, the p-value, the decision of null hyphothesis, and the corresponding interpretation.

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TABLE 3
REGRESSION ANALYSIS

	Student Engagement in Mathematics (DV)						
	Unstandardized Coefficients		Standardized Coefficients				
	B	Std. Error	Beta	t	p value	Decision on Ho	Interpretation
Constant	0.218	0.123		1.775	0.078		
Self-Efficacy in Mathematics (IV_1)	0.140	0.064	0.132	2.195	0.029	Reject Ho	Significant
Persistence in Mathematics (IV_2)	0.762	0.061	0.755	12.52	0.000	Reject Ho	Significant

R = 0.863; R^2 = 0.744; Adjusted R^2 = 0.741; F-value = 263.0; p-value = 0.000

Specifically, the table shows that the model for student engagement in mathematics using self-efficacy and student persistence as predictors is SEM = 0.140SM + 0.762PM + 0.218. The R^2 value of 0.744 indicates that the strenght of the model is very strong. The p-value of 0.000, which is less than 0.05 confidence level, is indicating that the model to forecast student engagement in mathematics using sel-efficay and student persistence as predictor is significant. Nonetheless, 0.256 of variance in the strength of the model was not explained by the predictors.

The model for student engagement in mathematics using self-efficacy and persistence as predictors is very strong and statistically significant, indicating that these variables effectively explain and predict students' engagement.

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Summary of Findings

Based on the statistical results, the following findings were obtained: 1. Self-efficacy, and student persistence significantly correlate with mathematics engagement. 2. The model for mathematics engagement, using student persistence and self-efficacy, as predictors is strong and significant.

The finding that self-efficacy and student persistence are significantly correlated with mathematics engagement, confirms that self-efficacy has a significant positive relationship with students' engagement in mathematics, indicating that higher confidence leads to greater participation and involvement in learning (Street et al. 2024) . Similarly, this current finding validates the study of Djekourmane et al. (2025), establishing that self-efficacy is significantly related to mathematics-related outcomes and behaviors, reinforcing its strong association with engagement and persistence in learning . However, the current finding contradicts Li et al. (2023) who reported that the relationship between self-efficacy and student engagement may not always be significant when influenced by external factors such as classroom environment and instructional support, suggesting that contextual variables may weaken its predictive power. The study of Li et al covers only 162 respondents whereas the current study included 184 respondents.

The finding that the model for mathematics engagement, using self-efficacy and student persistence as predictors, is strong and significant substantiates that self-efficacy serves as a significant predictor of students' engagement in mathematics, indicating that higher confidence leads to greater participation and involvement in learning (Hidayatullah et al., 2024). Similarly, this current finding is consistent with the study of Zhuofan (2024), establishing that self-efficacy significantly influences learning engagement and outcomes, reinforcing its predictive role alongside persistence in mathematics learning. However, the current finding contradicts Putwain et al. (2024), who reported that the predictive effect of self-efficacy on engagement may weaken when students experience high levels of academic anxiety, suggesting that emotional and contextual factors may influence the relationship. The study of Putwain involved 158 student respondents**,** which is fewer than the 184 participants.

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Conclusion

Based on the findings , it is concluded that mathematics engagement is partially, strongly(74.4%) and significantly predicted by self-efficacy and student persistence. Thus, Expectancy-Value Theory (EVT), demonstrating that a learner motivation to engage in a task is primarily determined by two key factors: expectancy of success and subjective task value**,** is partly affirmed.

Recommendations

Based on the conclusions, the following are recommended:

1. Future research may explore other potential variables not included in the study to account the remaining 25.6% of the variance in the predictive model. Exploratory study may generate themes which may be considered as potential variables.

2. Educators and curriculum developers may implement strategies that enhance learner persistence and self-efficacy to achieve optimal outcome in student engagement in mathematics

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