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PREDICTING MATHEMATICS PERFORMANCE AMONG GRADE 11 STUDENTS IN THE PHILIPPINES: EVIDENCE FROM REGRESSION MODELING AND MULTICOLLINEARITY ANALYSIS

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ABSTRACT

Mathematics performance is important for academic success and future opportunities among senior high school students in the Philippines. This study aimed to predict Mathematics performance among Grade 11 students using regression modeling and multicollinearity analysis. A quantitative research design was employed using secondary data from prior studies involving Grade 11 learners. The predictor variables included students' attitudes toward Mathematics, academic strand, sex, monthly family income, and parental educational attainment. Data were analyzed using correlation analysis, collinearity diagnostics, and multiple linear regression with stepwise procedures. Results showed that students' attitudes toward Mathematics were the most frequently identified influential factor. Regression analysis further revealed that High School Strand (STEM) and low monthly family income were significant predictors of Mathematics performance ($p < 0.05$), while sex and father's educational attainment showed marginal significance. Multicollinearity diagnostics indicated interrelationships among several predictors, particularly those related to socioeconomic and parental factors. The final regression model identified High School Strand (STEM), low family income, and sex as the most stable predictors of Mathematics performance. These findings highlight the combined influence of academic preparation and socioeconomic context in shaping student achievement. The study underscores the importance of addressing both cognitive and contextual factors in improving Mathematics outcomes in Philippine senior high schools.

Keywords: *- Mathematics performance, multicollinearity, regression model, predictors of Mathematics performance,*

INTRODUCTION

Mathematics is a highly structured discipline that involves patterns, relationships, and abstract structures inherent in numbers and systems. It serves as a universal language for expressing and analyzing quantitative information, making it essential in both practical and scientific applications. Ellenberg (2014) emphasizes that mathematics is not merely a collection of techniques but a way of thinking that promotes logical reasoning and precision in understanding complex phenomena. Its applications extend across disciplines such as computer science, economics, physics, and engineering, where it is used to model real-world situations,

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generate hypotheses, and derive evidence-based conclusions.

Despite its importance, Mathematics remains a challenging subject for many learners. Students often struggle with abstract reasoning, symbolic representation, and conceptual understanding. Negative attitudes and mathematics anxiety further hinder learning outcomes and performance (Boaler, 2013). These difficulties highlight the need to better understand the factors that influence students' Mathematics achievement.

In the Philippines, Mathematics education has undergone significant reforms through the K to 12 Basic Education Program, which aims to strengthen critical thinking, problem-solving, and STEM readiness. The Department of Education has emphasized inquiry-based and learner-centered approaches, supported by curriculum enhancements and teacher professional development initiatives (DepEd Order No. 73, s. 2012; Republic Act No. 7836). Despite these reforms, national and international assessments such as the National Achievement Test and PISA continue to reveal persistent gaps in Mathematics performance among Filipino learners (OECD, 2012; TIMSS, 2019).

These persistent challenges suggest that Mathematics performance is influenced by multiple interacting factors. Prior studies identify a range of predictors, including cognitive abilities, attitudes toward Mathematics, instructional practices, curriculum design, socioeconomic status, parental education, and psychological factors (Cohen, 2011; Hiebert & Grouws, 2007; Sirin, 2005). Understanding how these variables interact is essential for developing more effective educational interventions.

In analyzing these relationships, multiple linear regression is commonly used to examine the effect of several predictor variables on a single outcome variable. The general model is expressed as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_{11} X_{11} + \varepsilon$$

where Y represents Mathematics performance, X_1 to X_k represent predictor variables, β_0 is the intercept, β_1 to β_k are regression coefficients, and ε is the error term (Field, 2018). This model allows researchers to quantify the influence of each predictor while controlling for the effects of others

However, a key issue in multiple regression analysis is collinearity, where predictor variables are highly correlated with one another. When this occurs, multicollinearity may arise, leading to inflated standard errors, unstable coefficient estimates, and reduced interpretability of the model (Hair et al., 2019). This makes it difficult to isolate the unique contribution of each predictor to the dependent variable.

To diagnose multicollinearity, statistical measures such as Variance Inflation Factor (VIF) and tolerance are commonly used. VIF measures the extent to which the variance of a regression coefficient is inflated due to multicollinearity, while tolerance represents the proportion of variance in a predictor not explained by other predictors (Johnson & Wichern, 2007). High VIF values and low tolerance values indicate the presence of problematic multicollinearity, which may compromise the reliability of regression results.

Given these concerns, addressing multicollinearity is essential in developing robust

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predictive models. Techniques such as variable elimination, dimensionality reduction, ridge regression, and elastic net methods have been proposed in statistical literature to mitigate its effects (Zou & Hastie, 2005; Wooldridge, 2015). These approaches help ensure more stable and interpretable models.

Although previous studies have examined individual predictors of Mathematics performance, limited research has focused on the interrelationships among these predictors as a system of variables. In particular, the presence of overlapping influences among cognitive, demographic, and socioeconomic factors remains underexplored. This gap highlights the need for a comprehensive multicollinearity analysis alongside regression modeling.

Statement of the Problem

The study aimed to predict Mathematics performance among Grade 11 students in the Philippines by identifying significant predictors using regression modeling and examining the presence of multicollinearity among these predictors.

It sought to answer the following questions:

1. What variables are commonly associated with students' Mathematics Performance?
2. What are the significant predictors to Mathematics Performance?
3. What is the result of the collinearity analysis among the commonly associated predictors of Mathematics Performance in terms of:
   a. Correlation Analysis
   b. Collinearity Statistics
   c. Collinearity diagnostics

Scope and Delimitations

This study examined the collinearity among selected predictors of Mathematics performance among Grade 11 students at PHINMA–University of Pangasinan College Urdaneta during the school year 2023–2024. The study involved 267 students enrolled in General Mathematics. The analysis focused on key academic, demographic, and socioeconomic variables identified as predictors of Mathematics performance, and examined their interrelationships using correlation analysis, collinearity statistics, and collinearity diagnostics.

The study was delimited to the identified predictors and their statistical relationships, with emphasis on multicollinearity and their combined influence on Mathematics performance. It did not explore other external factors not included in the dataset nor employ qualitative data collection methods. The findings aim to provide empirical insights into the interaction of predictors of Mathematics performance, which may serve as a basis for developing data-informed instructional strategies and interventions in Mathematics education.

Review of Related Literatures

The study of Mathematics performance has gained increasing attention in educational research due to its multifaceted nature and its importance in academic and professional development. Mathematics is widely recognized as a discipline that fosters critical thinking, problem-solving, and analytical reasoning, serving as a foundation for various fields such as science, technology, and economics. However, students often experience

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difficulties in Mathematics due to its abstract nature, with factors such as anxiety, motivation, and interest significantly influencing learning outcomes (Pekrun et al., 2002; Richardson et al., 2012). Beyond cognitive and affective dimensions, external factors such as socioeconomic status, educational environment, cultural influences, peer interaction, and access to technology also play a crucial role in shaping students' academic performance (Sirin, 2005; Mullis et al., 2016). In the Philippine context, despite ongoing educational reforms under the K to 12 program, national and international assessments continue to reveal persistent gaps in Mathematics achievement, suggesting that performance is influenced by a combination of interrelated factors rather than isolated variables.

Learning and education further contextualize these influences, as learning is a continuous and experience-driven process, while education provides structured opportunities for cognitive and behavioral development (Smith, 1999–2020; Matusov, 2021). Mathematics education, in particular, aims to develop lifelong learning skills, yet remains challenging due to students' varying levels of motivation and anxiety. Additionally, the Philippine education system, shaped by historical and global influences, emphasizes specialized academic tracks in senior high school to prepare students for higher education and employment (Abby Granada). Empirical studies support the complexity of Mathematics performance determinants. Chang and Beilock (2016) highlighted the interaction between mathematics anxiety and performance across individual and environmental factors, while Gómez-García et al. (2020) found that ICT usage, gender, and educational level are associated with Mathematics achievement. Locally, Peteros et al. (2019) identified self-concept as significantly related to Mathematics performance, and Alipio (2020) demonstrated that psychological factors and expectancy-value beliefs influence academic achievement through both direct and mediated effects.

Despite the extensive literature on individual predictors of Mathematics performance, most studies have examined variables in isolation or within limited predictive frameworks. There is limited empirical attention on the interrelationships among multiple predictors and the potential presence of multicollinearity, which may affect the stability, interpretability, and validity of regression-based models. Addressing this gap is essential for developing more robust predictive models that account for the simultaneous effects of cognitive, psychological, demographic, and socioeconomic variables. In response, this study employs regression modeling and multicollinearity analysis to examine how multiple predictors collectively influence Mathematics performance among Grade 11 students in the Philippines, providing a more comprehensive understanding of the structural relationships among key variables.

Theoretical Framework

This study is anchored on several interrelated theoretical perspectives that provide a foundation for understanding the predictors of Mathematics performance and their statistical interrelationships. Cognitive Load Theory (Sweller, Ayres, & Kalyuga, 2011) explains how the complexity of mathematical tasks and limitations in cognitive resources influence students' learning and performance, highlighting the importance of managing instructional demands in Mathematics education. Expectancy-Value Theory (Eccles & Wigfield, 2000) posits that students' expectations of success and the value they assign to

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Mathematics significantly influence their academic achievement. Similarly, Motivation-Performance Theory (Covington, 2002) emphasizes the role of intrinsic and extrinsic motivation in shaping students' engagement and performance in Mathematics.

In addition, Social Cognitive Theory, particularly the concept of self-efficacy (Bandura, 2001), suggests that students' beliefs in their capability to succeed in Mathematics strongly affect their actual performance outcomes. Parental Involvement Theory (Baumrind & Hill, 2009) further highlights the influence of family support and engagement on students' academic success, including Mathematics achievement. From a methodological perspective, Multicollinearity Theory (Cameron & Trivedi, 2005) provides a statistical framework for identifying and addressing interrelationships among predictor variables in regression models, using diagnostics such as Variance Inflation Factor (VIF) to ensure model validity.

Finally, Systems Theory (Bertalanffy, 2015) offers a holistic perspective by viewing academic performance as the result of interacting and interdependent variables rather than isolated factors. This perspective supports the examination of Mathematics performance as a system of interconnected predictors, where relationships among variables must be considered in predictive modeling. Collectively, these theories provide a comprehensive framework for analyzing how cognitive, motivational, social, and statistical factors interact to influence Mathematics performance among Grade 11 students.

Conceptual Framework

1. **Profile of the Respondents, in terms of:**
   - *Strand*
   - *General Point Average (GPA)*
   - *Type of School Attended*
   - *Highest Educational Attainment of Parents*
   - *Nature of Work of Parents*
   - *Occupation of Parents*
   - *Number of Children in Family*
   - *Birth Order*
   - *Family Income*
   - *Availability of Learning Materials*
   - *Study Time*

2. **Predictors of Mathematics Performance, including:**
   - *Behavioral Activity Beliefs*
   - *Constructivism Activity Beliefs*
   - *Pragmatism Activity Beliefs*
   - *Learning Materials*
   - *Classroom Set-Up*
   - *Teaching Practices*
   - *Teacher's Motivation*

- **Preparation of research instruments (survey questionnaire)**
- **Validation of research instruments**
- **Administration of questionnaires to respondents**
- **Data collection and organization**
- **Statistical Treatment and Analysis of Data:**
  - ➢ *Identification of predictors of Mathematics performance*
  - ➢ *Descriptive statistics (frequency, percentage, mean)*
  - ➢ *Regression analysis (to determine significant predictors)*
  - ➢ *Model development for predicting Mathematics performance*
  - ➢ *Correlation analysis (to examine relationships among predictors)*
  - ➢ *Collinearity statistics (Tolerance and*

- **Identified significant predictors of Mathematics performance**
- **Developed regression model of Mathematics performance**
- **Collinearity analysis results among predictors**
- **Valid and reliable predictive model**
- **Evidence-based insights for improving Mathematics performance among Grade 11 students**

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• *Student's Motivation* • *Achievement Goal Orientation* • *Math Anxiety* • *Level of Stress* • *Level of Grit* • *Attitude towards Mathematics* • *Learning Styles*	*Variance Inflation Factor)* ➢ *Collinearity diagnostics (e.g., condition index)* • Interpretation of results	
INPUT	**PROCESS**	**OUTPUT**

METHODOLOGY

This quantitative research study examined the predictors of Mathematics Performance among Grade 11 students and assessed the presence of multicollinearity among these variables in a Philippine educational context.

RESEARCH DESIGN

This study employed a descriptive-correlational research design to examine the relationships among predictors of Mathematics performance and to assess the presence of multicollinearity among these variables. The design is appropriate as it allows the analysis of naturally occurring relationships without manipulation of variables. Specifically, the study aimed to identify significant predictors of Mathematics performance and evaluate the interrelationships among these predictors using regression modeling and collinearity diagnostics.

RESEARCH STEPS

The study followed a systematic procedure. First, relevant theses and dissertations were reviewed to identify commonly used predictors of Mathematics performance. Second, a survey questionnaire was developed and validated to gather data on demographic, academic, and psychological variables. Third, data were collected from selected respondents. Fourth, statistical analyses were conducted, including descriptive statistics, regression modeling, and collinearity assessment using correlation analysis, collinearity statistics, and collinearity diagnostics. Finally, the results were interpreted to determine significant predictors and assess the presence of multicollinearity.

DATA COLLECTION AND SAMPLE SELECTION

The study was conducted at PHINMA–University of Pangasinan College Urdaneta during the school year 2023–2024. The respondents consisted of 267 Grade 11 students enrolled in General Mathematics, selected through random sampling. Inclusion criteria required that participants be officially enrolled in the subject during the specified academic year.

Data were collected using a structured survey questionnaire adapted from previous studies. The instrument gathered information on demographic characteristics, academic background, psychological factors, and educational experiences. Mathematics performance was measured using students' recorded grades in General Mathematics. Prior to data collection, permission was secured from the school administration, and participation was conducted in accordance with ethical standards.

DATA ANALYSIS METHODS

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Data were analyzed using SPSS (Version 20). Descriptive statistics, including frequency, percentage, and mean, were used to summarize the characteristics of the respondents and the identified predictors.

To determine significant predictors of Mathematics performance, multiple linear regression analysis was employed. A stepwise regression method was used to refine the model by selecting the most relevant predictors while eliminating variables that contributed to multicollinearity.

To examine relationships among predictors, correlation analysis was conducted. Furthermore, collinearity statistics, including Variance Inflation Factor (VIF) and tolerance, were used to assess the presence of multicollinearity. A VIF value greater than 10 and tolerance values below 0.10 were considered indicative of multicollinearity.

Additionally, collinearity diagnostics, such as eigenvalues and condition indices, were utilized to further evaluate the severity of multicollinearity. A condition index greater than 15 was interpreted as a sign of potential multicollinearity. These analyses ensured the validity, stability, and interpretability of the regression model.

RESEARCH HYPOTHESES AND VALIDATION

The study tested the following null hypotheses at a 0.05 level of significance:

H_{01}: There is no significant relationship between the predictors and the Mathematics performance of Grade 11 students.

H_{02}: There is no significant collinearity among the predictors of Mathematics performance.

Hypotheses were tested using regression analysis and collinearity diagnostics. The null hypotheses were rejected when the computed p-values were less than 0.05, indicating statistically significant relationships or the presence of multicollinearity among predictors.

STUDY LIMITATIONS AND ETHICAL CONSIDERATIONS

This study is subject to several limitations. First, it was limited to Grade 11 students from a single institution, which may affect the generalizability of the findings. Second, the use of self-reported data in the survey questionnaire may introduce response bias. Third, the study focused only on selected predictors and may not account for other relevant variables influencing Mathematics performance.

Ethical considerations were strictly observed throughout the study. Permission to conduct the research was obtained from the school administration. Participation was voluntary, and respondents were assured of the confidentiality and anonymity of their responses. Data were used solely for academic and research purposes.

RESULTS AND DISCUSSION

SOP 1. What variables are commonly associated with students' Mathematics Performance?

A review of 13 theses and dissertations from the Pangasinan State University – School of Advanced Studies revealed several variables associated with students' Mathematics performance, highlighting the multidimensional nature of academic achievement. The

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frequency distribution of these predictors is presented in Table 1.

Table 1
Variables Commonly Associated with Students' Mathematics Performance

Variable Name	Utilization
Attitude toward Mathematics	38%
Highest Educational Attainment of Parents	31%
Estimated Family Income	31%
Sex	23%
Achievement Goal Orientation	23%
Learning Styles	23%
Strand	15%
Nature of Work of parents	15%
Occupation of Parents	15%
Student's Motivation	15%
Level of Stress	15%
Type of School Attended	8%
Number of Children in the Family	8%
Birth Order	8%
Learning Materials at Home	8%
Time Spent in Studying	8%
Behavioral Activity Beliefs	8%
Constructivism Activity Beliefs	8%
Pragmatism Activity Beliefs	8%
Learning Materials	8%
Classroom Set-Up	8%
Teaching Practices	8%
Teacher's Motivation	8%
Math Anxiety	8%
Level of Grit	8%

Table 1 shows that Attitude toward Mathematics emerged as the most frequently identified variable, appearing in 38% of the reviewed studies. This suggests that students' perceptions, interest, and disposition toward Mathematics play a crucial role in influencing their academic performance, reinforcing the importance of addressing affective factors in instruction.

Highest educational attainment of parents and estimated family income were both identified in 31% of the studies, indicating that family background and economic conditions significantly contribute to students' Mathematics performance. These findings highlight the role of home support and access to resources in shaping academic outcomes.

Sex, achievement goal orientation, and learning styles were reported in 23% of the reviewed studies. These variables suggest that both individual differences and motivational orientations influence how students engage with and perform in Mathematics.

Variables such as high school strand, nature and occupation of parents, student motivation, and level of stress appeared in 15% of the studies. These findings reflect the combined effects of academic background, family context, and psychological conditions on students' performance.

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Other predictors, including type of school attended, number of children in the family, birth order, learning materials at home, time spent studying, belief systems, classroom environment, teaching practices, teacher motivation, mathematics anxiety, and level of grit, were least represented, each appearing in 8% of the studies. Although less frequently cited, these factors may still contribute to performance under specific contexts.

Overall, the findings indicate that while numerous variables are associated with Mathematics performance, only a subset consistently emerges across studies. Variables with at least 15% occurrence were selected for further analysis to examine their predictive power and interrelationships through regression modeling and multicollinearity analysis. This approach ensures a focused and evidence-based selection of predictors for model development.

SOP 2. What are the significant predictors to Mathematics Performance?

Linear regression analysis was employed to examine the extent to which selected predictors influence Mathematics performance while accounting for potential collinearity among variables. The initial model (longest model) included all predictors with at least 15% utilization identified from the document analysis.

Table 2

Linear Regression Model of Mathematics Performance Using the Longest Model

Significance		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
	Intercept	83.379	2.122		39.284	.000
Significant	HS Strand (STEM)	1.795	.680	.197	2.641	.009
	Monthly Family Income (Low)	-1.483	.704	-.167	-2.107	.036
Marginally Significant	Highest education of Father (HS)	-1.203	.651	-.130	-1.847	.066
	Sex	.958	.530	.108	1.807	.072
	Learning Styles (Strongly Global)	-2.641	1.575	-.102	-1.677	.095
Not significant	Highest education of Mother (Vocational)	.952	1.074	.054	.886	.377
	Highest education of Father (Vocational)	-.800	1.021	-.052	-.784	.434
	Learning Styles (Slightly Global)	-1.175	1.633	-.043	-.719	.473
	Goal Orientation	.355	.541	.056	.656	.513
	Work of Mother (Self-Employed)	-.546	.837	-.047	-.652	.515
	Occupation of Mother (Blue Collar)	-.416	.673	-.043	-.618	.537
	Occupation of Mother (White Collar)	-.451	.752	-.048	-.599	.550
	Monthly Family Income (High)	.391	.705	.040	.554	.580
	HS Strand (HUMSS)	-.497	.901	-.041	-.552	.582
	Attitude toward Math	.210	.532	.033	.395	.693
	Level of Stress	-.134	.383	-.022	-.349	.728
	Work of Father (Self-Employed)	-.913	4.341	-.093	-.210	.834
	Occupation of Father (Blue Collar)	.809	4.356	.092	.186	.853
	Work of Father (Employed)	-.603	4.325	-.068	-.139	.889
	Highest Education of Mother (HS)	-.055	.683	-.006	-.080	.936
	Motivation	-.041	.531	-.007	-.078	.938
	Occupation of Father (White Collar)	.049	4.402	.005	.011	.991

Legend:

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- Sex (0 – Male, 1 – Female),
- Strand (1 0 – STEM, 0 1 – HUMSS, 0 0 – ABM, GAS, TVL),
- Highest Education of Father (1 0 – High School, 0 1 – Vocational/2-Year Course),
- Highest Education of Mother (1 0 – High School, 0 1 – Vocational/2-Year Course),
- Nature of Work – Father (1 0 – Employed, 0 1 – Self-Employed, 0 0 – Unemployed),
- Nature of Work – Mother (1 0 – Employed, 0 1 – Self-Employed, 0 0 – Unemployed),
- Occupation of Father (1 0 – White Collar, 0 1 – Blue Collar, 0 0 – Unemployed),
- Occupation of Mother (1 0 – White Collar, 0 1 – Blue Collar, 0 0 – Unemployed),
- Learning Styles (1 0 – Strongly Global, 0 1 Slightly Global, 0 0 – Global Analytic),
- Monthly Family Income (1 0 – Low Income, 0 1 – Middle Income, 0 0 – High Income)

The results showed that only two variables—high school strand (STEM) and monthly family income (low)—were statistically significant predictors of Mathematics performance, with p-values of 0.009 and 0.036, respectively. These values are below the 0.05 level of significance, indicating a strong relationship with Mathematics performance. In contrast, highest educational attainment of father (high school), sex, and learning styles (strongly global) were found to be marginally significant, with p-values between 0.05 and 0.10. The remaining variables were not statistically significant, suggesting limited predictive value within the model.

The findings indicate that academic track and socioeconomic status play a crucial role in predicting Mathematics performance. Students enrolled in the STEM strand tend to perform better, while those from lower-income households show comparatively lower performance. Meanwhile, variables such as parental education, sex, and learning styles demonstrate moderate influence but require further validation due to their marginal significance.

The presence of non-significant predictors in the initial model may be attributed to collinearity, which can inflate standard errors and obscure the true effect of individual variables. This reinforces the importance of identifying and addressing multicollinearity to improve model accuracy and interpretability. To address this issue, stepwise regression was applied to systematically retain only statistically significant and independent predictors. The result of the stepwise regression is shown at Table 3 below:

Table 3
Stepwise Linear Regression Model of Mathematics Performance

Variable	**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
	B	**Std. Error**	**Beta**		
Intercept	83.753	.574		145.966	.000
HS Strand (STEM)	2.045	.532	.225	3.845	**.000**
Monthly Family Income (Low)	-1.863	.520	-.209	-3.582	.000
Sex	1.174	.514	.132	2.282	.023

The stepwise regression analysis resulted in a reduced model consisting of three significant predictors: high school strand (STEM), monthly family income (low), and sex. All three variables demonstrated statistical significance ($p < 0.05$), confirming their predictive value. The unstandardized coefficients indicate that being in the STEM strand is associated

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with an increase in Mathematics performance (β = 2.045), while belonging to a low-income group is associated with a decrease in performance (β = -1.863). Additionally, sex was found to have a positive association with performance (β = 1.174).

The resulting regression model is expressed as:

$$\hat{y} = 83.753 + 2.045x_1 - 1.863x_2 + 1.174x_3$$

Where:

$x_1 = HS\ Strand\ (STEM)$

$x_2 = Monthly\ Family\ Income\ (Low)$

$x_3 = Sex$

The reduction of the model to three key predictors highlights the importance of simplifying regression models to improve accuracy and interpretability. The findings emphasize that not all commonly associated variables significantly contribute to predicting Mathematics performance, particularly when collinearity is present. The final model provides a more reliable basis for identifying students at risk and for designing targeted educational interventions.

SOP 3. What is the result of the collinearity analysis among the commonly associated predictors of Mathematics Performance in terms of:

a. Correlation Analysis

The collinearity analysis was conducted to examine the relationships among predictors of Mathematics Performance and to detect potential multicollinearity issues that may affect regression estimates. Correlation analysis, including zero-order, partial, and part correlations, was utilized to assess both the direct and unique contributions of each predictor.

Table 4

Result of Analysis of Correlation Between Mathematics Performance and the Commonly Utilize d Variables

Significance		**Correlations**		
		Zero-order	**Partial**	**Part**
Significant	HS Strand (STEM)	.258	.167	.153
	Monthly Family Income (Low)	-.240	-.134	-.122
Marginally Significant	Highest education of Father (HS)	-.184	-.117	-.107
	Sex	.126	.115	.105
	Learning Styles (Strongly Global)	-.123	-.107	-.097
Not significant	Highest education of Mother (Vocational)	.036	.057	.051
	Highest education of Father (Vocational)	.004	-.050	-.045
	Learning Styles (Slightly Global)	-.047	-.046	-.042
	Goal Orientation	.118	.042	.038
	Work of Mother (Self-Employed)	-.080	-.042	-.038
	Occupation of Mother (Blue Collar)	.008	-.040	-.036

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Occupation of Mother (White Collar)	-.015	-.038	-.035
Monthly Family Income (High)	.124	.035	.032
HS Strand (HUMSS)	-.172	-.035	-.032
Attitude toward Math	.143	.025	.023
Level of Stress	-.026	-.022	-.020
Work of Father (Self-Employed)	-.108	-.013	-.012
Occupation of Father (Blue Collar)	.050	.012	.011
Work of Father (Employed)	.109	-.009	-.008
Highest Education of Mother (HS)	-.095	-.005	-.005
Motivation	.111	-.005	-.005
Occupation of Father (White Collar)	-.039	.001	.001

Results revealed that HS Strand (STEM) exhibited a significant low positive correlation with Mathematics Performance ($r = 0.258$), which remained significant after controlling for other variables (partial $r = 0.167$; part $r = 0.153$). Conversely, Monthly Family Income (Low) showed a significant low negative correlation ($r = -0.240$), which also persisted after controlling for other predictors (partial $r = -0.134$; part $r = -0.122$).

Several variables demonstrated marginal significance, including Highest Education of Father (HS) ($r = -0.184$; partial $r = -0.117$; part $r = -0.107$), Sex ($r = 0.126$; partial $r = 0.115$; part $r = 0.105$), and Learning Styles (Strongly Global) ($r = -0.123$; partial $r = -0.107$; part $r = -0.097$). Other predictors were found to have no statistically significant relationship with Mathematics Performance, suggesting limited influence on the outcome variable.

b. Collinearity Statistics

Collinearity statistics further indicated varying levels of multicollinearity among predictors. Variables such as Learning Styles (Slightly Global), Sex, Learning Styles (Strongly Global), and Highest Education of Mother (Vocational) demonstrated low collinearity, as reflected by high tolerance values (0.907–0.959) and low VIF values (1.042–1.11). Most predictors exhibited moderate collinearity (tolerance = 0.411–0.858; VIF = 1.165–2.432), which is generally acceptable and unlikely to compromise model stability.

Table 5
Report of Collinearity Statistics

Variable Name	Collinearity Statistics	
	Tolerance	**VIF**
Learning Styles (Slightly Global)	.959	1.042
Sex	.950	1.053
Learning Styles (Strongly Global)	.907	1.103
Highest education of Mother (Vocational)	.901	1.110
Level of Stress	.858	1.165
Highest education of Father (Vocational)	.766	1.306
Occupation of Mother (Blue Collar)	.687	1.457
Highest Education of Mother (HS)	.682	1.466

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Highest education of Father (HS)	.675	1.481
Monthly Family Income (High)	.650	1.538
Work of Mother (Self-Employed)	.644	1.553
HS Strand (HUMSS)	.607	1.647
HS Strand (STEM)	.604	1.656
Monthly Family Income (Low)	.538	1.859
Occupation of Mother (White Collar)	.517	1.936
Attitude toward Math	.486	2.056
Goal Orientation	.459	2.179
Motivation	.411	2.432
Work of Father (Self-Employed)	.017	57.782
Occupation of Father (White Collar)	.015	67.968
Work of Father (Employed)	.014	70.201
Occupation of Father (Blue Collar)	.014	72.591

However, severe multicollinearity was observed among variables related to the father's occupation and employment status, including Work of Father (Self-Employed), Work of Father (Employed), Occupation of Father (White Collar), and Occupation of Father (Blue Collar). These variables showed very low tolerance values (0.014–0.017) and extremely high VIF values (57.782–72.591), indicating substantial redundancy and instability in coefficient estimation.

c. Collinearity diagnostics

Collinearity diagnostics supported these findings. While several dimensions exhibited condition indices greater than 15, only Dimension 23 indicated a serious collinearity issue, as multiple predictors (Work of Father [Employed and Self-Employed] and Occupation of Father [White Collar and Blue Collar]) had variance proportions exceeding 0.90. This confirms the presence of a localized multicollinearity problem among these variables.

Table 6

Collineaity Diagnostics

Dimension	Eigenvalue	Condition Index	Variance Proportions																					
			(Constant)	Attitude toward Math	Goal Orientation	Motivation	Level of Stress	SEX	HS Strand (STEM)	HS Strand (HUMSS)	Highest education of Father (HS)	Highest education of Father (Vocational)	Highest Education of Mother (HS)	Highest education of Mother (Vocational)	Work of Father (Employed)	Work of Father (Self Employed)	Work of Mother (Self Employed)	Occupation of Father (White Collar)	Occupation of Father (Blue Collar)	Occupation of Mother (White Collar)	Occupation of Mother (Blue Collar)	Learning Styles (Strongly Global)	Learning Styles (Slightly Global)	Monthly Family Income (Low)	Monthly Family Income (High)
1	10.492	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1.791	2.421	0	0	0	0	0	0	0	0	0.01	0	0.03	0	0	0	0.05	0	0	0.04	0.03	0.01	0.01	0.01	0
3	1.347	2.791	0	0	0	0	0	0	0	0	0.04	0.07	0.04	0.03	0	0	0.02	0	0	0	0	0.01	0.04	0.02	0.04
4	1.252	2.895	0	0	0	0	0	0	0.01	0.04	0	0.12	0	0.11	0	0	0.01	0	0	0	0.01	0.03	0	0.02	0.02
5	1.125	3.054	0	0	0	0	0	0	0.02	0.17	0	0.03	0	0.04	0	0	0	0	0	0	0	0.27	0.01	0	0.01
6	0.989	3.257	0	0	0	0	0	0	0	0.01	0.01	0	0.01	0.03	0	0	0.01	0	0	0.01	0.03	0.06	0.49	0	0.04
7	0.92	3.377	0	0	0	0	0	0	0	0	0.02	0.03	0	0.22	0	0	0	0	0	0	0	0.09	0.25	0.02	0.07
8	0.863	3.486	0	0	0	0	0	0	0.01	0.1	0	0.2	0	0.01	0	0	0.02	0	0	0.01	0	0.33	0	0	0
9	0.79	3.645	0	0	0	0	0	0	0	0.01	0	0.05	0.02	0.34	0	0	0	0	0	0.02	0.12	0	0.14	0.02	0.03
10	0.657	3.998	0	0	0	0	0	0	0.01	0.01	0.1	0.01	0.07	0.06	0	0	0.12	0	0	0	0.11	0.02	0	0.01	0.09
11	0.617	4.123	0	0	0	0	0	0.06	0	0.05	0.07	0	0.03	0.02	0	0	0.08	0	0	0.03	0.05	0.08	0.02	0.01	0.07
12	0.489	4.632	0	0	0	0	0	0.02	0.02	0.01	0	0.19	0.1	0	0	0	0.24	0	0	0	0.16	0	0.02	0	0.01
13	0.382	5.243	0	0	0	0	0	0.78	0.02	0.01	0.01	0.01	0	0	0	0	0.05	0	0	0	0.01	0.05	0	0.01	0.02
14	0.34	5.554	0	0	0	0	0	0.03	0.02	0.01	0.36	0.09	0.61	0.1	0	0	0	0	0	0	0.02	0.02	0.01	0.07	0.02
15	0.285	6.065	0	0	0	0	0	0	0.03	0.03	0	0.01	0.03	0	0	0	0.24	0	0	0.44	0.08	0	0.01	0	0
16	0.252	6.459	0	0	0	0	0	0.07	0.01	0.01	0.26	0.1	0	0.01	0	0	0	0	0	0.04	0.08	0	0	0.49	0.36
17	0.196	7.318	0	0	0	0	0	0	0.43	0.35	0.05	0.05	0.03	0.01	0	0	0.1	0	0	0.3	0.14	0	0	0.06	0.02
18	0.129	9.021	0	0.01	0.01	0.01	0.04	0.01	0.36	0.13	0.03	0.02	0	0	0	0	0.04	0	0	0.05	0.09	0	0	0.19	0.16
19	0.048	14.816	0	0.02	0.01	0.06	0.68	0.01	0.01	0.02	0.01	0.01	0	0	0	0	0	0	0	0	0.01	0	0	0.01	0
20	0.013	27.939	0.2	0.56	0.26	0.15	0.07	0	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0.02
21	0.013	28.949	0.74	0.3	0.07	0.03	0.19	0	0.02	0.02	0.01	0.01	0	0	0	0	0	0	0	0.04	0.05	0.01	0	0.04	0.02
22	0.01	31.934	0.05	0.1	0.62	0.72	0.02	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0.03	0.01	0	0
23	0.002	71.618	0	0	0.03	0.03	0	0	0.01	0	0.01	0	0.01	0	0.99	0.98	0	0.98	0.99	0	0.01	0	0	0	0

Overall, the findings suggest that while most predictors demonstrate acceptable levels of collinearity, specific variables—particularly those related to the father's employment and occupation—require careful consideration or possible exclusion in regression modeling to

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ensure the stability and interpretability of results.

SUMMARY

This study examined the predictors of Mathematics Performance and assessed the presence of multicollinearity among these variables using data from Grade 11 students at Phinma – University of Pangasinan College Urdaneta. A preliminary review of 13 graduate theses and dissertations identified commonly associated variables, with Attitude toward Mathematics, parental educational attainment, and family income emerging as the most frequently cited predictors.

Regression analysis revealed that HS Strand (STEM) and Monthly Family Income (Low) were the only significant predictors of Mathematics Performance, while Highest Education of Father (HS), Sex, and Learning Styles (Strongly Global) demonstrated marginal significance. A stepwise regression model was developed, incorporating three predictors to optimize model parsimony and reduce redundancy.

Correlation analysis indicated that HS Strand (STEM) had a significant positive relationship with Mathematics Performance, whereas low family income exhibited a significant negative relationship. Other variables showed only marginal associations, suggesting limited explanatory power.

Collinearity assessment revealed that most predictors exhibited acceptable to moderate levels of multicollinearity. However, severe multicollinearity was detected among variables related to the father's occupation and employment status, as indicated by extremely low tolerance values and high variance inflation factors. Collinearity diagnostics further confirmed a localized multicollinearity issue within a specific dimension, where several predictors shared substantial variance.

Overall, the findings highlight that while selected socioeconomic and academic variables significantly influence Mathematics Performance, the presence of multicollinearity among certain predictors necessitates careful variable selection to ensure stable and reliable regression estimates.

CONCLUSIONS

This study examined the collinearity among predictors of Mathematics Performance among Grade 11 students at Phinma – University of Pangasinan College Urdaneta, highlighting the complex interaction of academic, socioeconomic, and demographic factors influencing student achievement. Mathematics, as a fundamental discipline for developing critical thinking and problem-solving skills, remains a key area of concern in educational systems, including the Philippines, despite ongoing reforms and interventions.

The review of thirteen theses and dissertations revealed that Attitude toward Mathematics was the most frequently cited predictor, while several contextual variables were minimally represented. Regression analysis identified HS Strand (STEM) and Monthly Family Income (Low) as significant predictors of Mathematics Performance, while Highest Education of Father (HS), Sex, and Learning Styles (Strongly Global) showed marginal significance. The final stepwise regression model retained HS Strand (STEM), Monthly Family Income (Low), and Sex as the primary predictors, forming a simplified but meaningful predictive model of Mathematics Performance.

Findings further indicate that socioeconomic and demographic variables have a measurable influence on Mathematics Performance, with STEM strand background and low family income emerging as the most consistent predictors. Although other variables exhibited weaker associations, their marginal significance suggests potential contributory roles under certain conditions.

Collinearity diagnostics revealed generally acceptable levels of multicollinearity among most predictors; however, severe collinearity was observed among variables related to the father's employment and occupational status. This indicates redundancy among these variables and highlights the need for careful variable selection in regression modeling to ensure stability and interpretability of results.

Overall, the study underscores that Mathematics Performance is shaped by a combination of academic preparation and socioeconomic context, while also emphasizing the importance of addressing multicollinearity to improve the robustness of predictive models.

RECOMMENDATIONS

Based on the findings of the study, further research is recommended to examine the effects of multicollinearity on the stability and predictive accuracy of regression models in Mathematics Performance. In particular, future studies may investigate underexplored variables such as Type of School Attended and Learning Materials to develop a more comprehensive understanding of factors influencing student achievement. Additionally, the significant predictors identified in this study, namely HS Strand (STEM) and Monthly Family Income (Low), should be further examined to establish the consistency and extent of their effects across different populations. Finally, the multicollinearity observed among variables related to the father's employment and occupation warrants further investigation to improve model specification and enhance the robustness of predictive analyses in Mathematics Performance research.

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