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Research Article

Mathematics Academic Performance: Multiple Regression Analysis Model

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ABSTRACT

A multiple regression model was established based on the examination of factors of academic performance among BSEd Mathematics students during the academic year 2023-2024 of J.H. Cerilles State College-Dumingag Campus. The data of the participants' perceptions of the extent of teachers' support, instructional competence, and participants' academic engagement were examined to determine if these constituted factors of students' academic performances. This study employed a quantitative design, utilizing multiple regression analysis. Adapted questionnaire checklists were used, and data were analyzed using a five-point Likert scale. A reliability test using the Cronbach alpha coefficient was determined using Jamovi software. The study included students from the first to fourth year of BSEd Mathematics at J.H. Cerilles State College-Dumingag Campus, Dumingag, Zamboanga del Sur, who are currently pursuing a Bachelor of Secondary Education major in Mathematics for the academic year 2023-2024. The weighted arithmetic mean, frequency, and percentage distribution were used to treat the descriptive questions. The study revealed that the teachers provided a high level of support to students' mathematics learning and were competent in providing quality instructions among mathematics students. The students exhibited a high level of academic engagement; and performed well in their mathematics major subjects. Teachers' support, instructional competence, and student academic engagement were significant correlates of mathematics students' academic performances. The high level of teacher's support is manifested in the way the teachers encourage the students to explore more problem-solving exercises and assist them whenever they encounter difficulties. The teacher's instructional competence is evident when they encourage students' interest, motivation, and participation. There is a high level of academic engagement when the students practice more drills. The students acquired skills and competences in math learning areas. The study recommends that the students may promote self- directed learning and motivation among

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students to improve their academic engagement and performance in mathematics; the mathematics educators may implement strategies to increase academic engagement through fostering individual tasks and collaboration to develop students' mathematics skills and dependence; the curriculum designers may design mathematics curricula align with educational standards that promote the development of essential mathematics competencies among students; the school administrators may foster a collaborative school that emphasizes the importance of mathematics education and supports ongoing research and innovation in teaching practices; the parents may advocate for parental involvement in actively supporting children's mathematical learning by providing resources, creating a supportive home environment, and reinforcing the value of mathematics education; and the future researchers may Investigate effective strategies and interventions for enhancing mathematics education and improving student outcomes in the subject.

Mathematics is a crucial subject in education, providing students with essential knowledge and skills. To boost academic performance, teachers need to provide intensive support, instructional competence, and student engagement. Siddiqi (2018) found a significant relationship between teachers' effort and students' academic progress, advocating for improved instruction-based classroom learning and good teacher-student connections.

Keywords*: Mathematics, Academic performance, Students, Multiple regression analysis, Model*

Introduction

Instructional competence in mixed-ability classrooms is crucial for students' academic performance. Teachers should use differentiated instruction methods to promote equity and effectiveness. Modern instructional strategies should foster smooth learning and application of mathematical skills. Student academic engagement is essential for learning, and the constructivist theory of learning suggests a shift from knowledge provision to learning facilitation. Teachers should focus on fostering student engagement and allowing them to discuss and communicate mathematically. Math engagement is a prerequisite for higher math-related careers and is influenced by factors like age, gender, and student classification. Socio-ecological systems theory also highlights the interaction among factors predicting math achievement.

The Philippines faces significant learning gaps in mathematics education, with students scoring below the OECD average of 472 points. A study on academic determinants among students in J.H. Cerilles State College-Dumingag Campus aims to close this gap and ensure students have the necessary knowledge and competencies for bachelor degree success.

Methods

This study employed a quantitative design utilizing regression analysis. The participants were 106 students from first year to fourth year of BSEd Mathematics of J.H. Cerilles State College-Dumingag Campus, Dumingag, Zamboanga del Sur, who currently took a Bachelor of Secondary Education major in Mathematics of the Academic Year 2023-2024. The 106 student-participants constituted about 90 percent of the total population of the BSEd Mathematics department.

The questionnaire checklist was used to gather the data for the study. It consisted of the following parts, namely: profile of the participants in terms of classification as a student and age; the questionnaire on Teacher

Support Adaptivity (QTSA): Questionnaire Evaluating Teaching Competencies in the University Environment (2015), and The Influence of Student Engagement on Mathematical Achievement among Secondary School Students (2021).

The research was constrained by the fact that the questionnaire-checklist approach used in the study meant that participant replies would not accurately reflect their genuine views and perceptions, and they might have tended to agree with assertions rather than offer thoughtful comments.

To determine the extent of teachers' support, level of teachers' instructional competence, and level of participants academic engagement, the researchers utilized the mean and the standard deviation. To determine the distribution of the participants' academic performance, frequency and percentage were utilized. The multiple regression analysis was done to establish the correlations between the factors and the students' academic performance in mathematics.

Results and Discussions

Extent of Teacher's Support, Instructional Competence and Students' Academic Engagement

Table 1 presents the data on the students' feedback on the extent of teachers' support, which had a mean that ranged from 3.21 to 4.03. This implies that the teachers are particularly effective in providing assistance to students when they are struggling and offers opportunities for further practice and development. The standard deviation of 0.45, which is relatively low, indicates that the participants' responses are fairly consistent. The overall mean score of 3.84 implies a relatively high level of teacher support. Hence, the teachers exhibit a strong level of support and assistance to the students in their mathematics learning. Studies have shown that teacher support, an essential contextual feature for meeting psychological needs, allows them to develop intrinsic motivation (Liu et al., 2021). Another study found that teacher support may generate good teacher-student connections that can improve students' intellectual skills within a classroom environment (Huang et al., 2022).

In terms of teachers' instructional competence, the overall mean score of 4.04 implies a high level. This signifies that the teachers are competent in various aspects of mathematics instruction. The work of Abiodun (2020) on teachers' skills as predictors of students' academic achievement in mathematics in secondary schools revealed that teacher skills of commitment, motivation, and communication significantly predict students' achievement in mathematics. Given that schools are achievement contexts and that one of the main functions of a school is to develop students' competencies and skills (Bureau, Howard, & Chong, 2022). The average mean of 3.98 indicates high academic engagement among the students. Hence, it follows that the participants exhibit a high level of academic engagement with their mathematics studies. This further. Implies that the higher levels of behavioral engagement, such as attending class and participating in learning activities; emotional engagement, such as students' interest in learning; and cognitive engagement, involving students' self-effort in learning, were the strongest predictors of academic performance.

Table 1. Extent of Teacher's Support, Instructional Competence and Students' Academic Engagement

Variables	Weighted Arithmetic Mean	Standard Deviation	Interpretation
Teacher's Support	3.84	0.45	High
Instructional Competence	4.04	0.48	Competent
Students' Academic Engagement	3.98	0.51	High

Participant's Academic Performance

Table 2 presents the distribution of participants' academic performance in their mathematics major subjects. Of the 106 student-participants, 2 participants or (2% of the total) are excellent, 62 participants or (58% of the total) are very good, 42 participants (40% of the total) are good. There were no participants

"Failed". The overall mean performance level is 1.98 which falls between the categories of "Good" (2.50-2.25) and "Very Good" (2.00-1.75). This distribution implies that the participants, as a whole, performed well in their mathematics major subjects, with majority achieving "Very Good" performance levels. Since, there was an absence of any participants who "failed", this further implies a generally high level of academic achievement in the mathematics major.

Table 2. Participant's Academic Performance in Mathematics Major Subjects

Category	Frequency	Percentage
Excellent. (1.50- 1.00)	2	2.00
Very Good. (2.00-1.75)	62	58.00
Good (2.50-2.25)	42	40.00
Passed (3.00-2.75)	0	0.00
Failed (5.00)	0	0.00
Total	106	100.00

Table 3.1. Model Summary of the Regression Analysis on Mathematics Academic Performance Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.548	.301	.251	.20895

The R value of 0.548 indicates a moderately positive correlation between the independent variable (teachers' support, teachers' instructional competence, and students' academic engagement) and the dependent variable (mathematics students' academic performances). The R square, which is 0.301, measures the proportion of the variance in mathematics student academic performance that is predictable from the teachers' support, teachers' instructional competence, and students' academic engagement. The adjusted R square of 0.251 means 25.1% can be explained by the teachers' support, teachers' instructional competence, and students' academic engagement after adjusting, which is a more accurate measure of the goodness of fit of the model.

Table 3.2. Regression Model Goodness-of-Fit Using ANOVA

Model	Sum of Squares	df	Mean Square	F	p value
Regression	1.840	7	.263	6.020	.000
Residual	4.279	98	.044		
Total	6.119	105			

The significance of the regression model goodness of fit is indicated by the p-value in the ANOVA table. In this case, the p-value is 0.000, which is less than.05. Therefore, the regression model is significant at the.05 level. This means that the model is a good fit for the data. Hence, the extent of the teacher's support, instructional competence, and students' academic engagement have all significant effects on mathematics student academic performance.

Table 3.3. Regression Model Estimated Model Coefficient

Model	Unstandardized Coefficients		Standardized Coefficients	t	p value
	B	Std. Error	Beta		
Constant	2.054	.302		6.801	.000
Type of Student	.179	.062	.266	2.876	.005*

Model	Unstandardized Coefficients		Standardized Coefficients	t	p value
	B	Std. Error	Beta		
Age	.010	.009	.108	1.105	.272
Support	.198	.069	.365	2.879	.005*
Competence	-.130	.058	-.261	-2.261	.026*
Engagement	-.126	.050	-.269	-2.546	.012*

The study employs multiple regression analysis to determine the predictors of participants academic performance. The coefficients represent the change in the dependent variable (mathematics student academic performance) for a one-unit change in the independent variable (Extent of Teachers' Support, Instructional Competence, and Student Academic Engagement). The type of student shows an impact on academic achievements. Regular students are more advantaged (.179 units) compared to irregular students. This implies that students who are regular are more likely to be focused on academic tasks, maybe because of the smooth time schedule in class. And this can be supported by Walberg's theory (1981) that one of his identified factors in academic achievement was student ability, and developmental level. In this case, the type of student would affect the academic performance, and by that, it is suggested that students drop subjects that had conflict with each other and enroll in the subject that they can manage at a time.

The teacher support has a positive and statistically significant impact on mathematics student performance. Specifically, for every one-unit increase in teacher support, mathematics student performance decreases by.198 units. This implies that teachers must not spoon feed everything to students but help them to be independent learners, facilitate them to explore, and create their own learning to develop their critical thinking, and problem-solving skills. Hence, teachers support students in developing their ability to solve problems, reason mathematically, and connect the mathematics they are learning to the real world around them. Teacher support can be vital to students' academic development, including not only learning outcomes (Lei, Cui, & Chiu, 2018).

In addition to that, instructional competence has a statistically significant impact on mathematics student performance. It appeared that for every one-unit increase in instructional competence, mathematics student performance decreases by.130 units. It should be considered that the grading system of the college where the participants come from used inverted grading assignments, that is, the highest rating is 1.00 and the lowest is 5.00. In this case, as the teacher exhibits high instructional competence, students are highly competent as a result. So, teachers' must be proficient in their subject matter; however, they must foster students' motivation and provide tasks that enhance critical thinking, collaboration, and independence in learning mathematics, where teachers must ensure students demonstrate high desirable values and attain the learning competency. In support of that, instructional competence is another well-established strategy that has examined various methods of instruction in order to facilitate students' learning in the classroom (Panayiotou, Herbert, & Sammons, 2021). As stated by Daher (2020), the significance of teachers' roles in creating a stimulating educational setting where students can interact with one another and maintain a positive attitude towards mathematics.

Student academic engagement is also statistically significant. For every one-unit increase in teachers' academic engagement, mathematics student performance increases by.126 units. This means that students must give maximum engagement in the mathematics learning process. They should consistently and actively participate in the class. This shows that in learning mathematics it should be learner-centered, where teachers must provide opportunities and tasks that encourage active participation from students. And since the best way to learn mathematics is by practicing it, teachers must give activities that require maximum effort for students to conceptualize and solve, where students can demonstrate mathematics

learning by doing. In this case, it revealed that in mathematics education, it should be more on actual engagement, where it demands students' effort, intellect, and willingness to learn. Moreover, students' engagement in mathematics is of great importance in raising the effectiveness of mathematics learning and teaching (Trenholm et al. 2018).

Therefore, the extent of teachers' support, instructional competence, and students' academic engagement are predictors of the mathematic students' academic performance in their mathematics major subjects.

Conclusions

1. The high level of teacher's support is manifested in the way the teachers encourage the students to explore more problem-solving exercises and assist them whenever they encountered difficulties.
2. The teacher's instructional competence is evident when they encourage student's interest, motivation, and participation.
3. There is a high level of academic engagement when the students practice more drills.
4. The students acquired skills and competences in math learning areas.
5. The extent of teacher's support, instructional competence, and academic engagement are predictors of mathematics student academic performances.

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