



Factors Predicting the Mathematics Performance of Grade 8 Students in the New Normal

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Abstract

Mathematics performance has been recognized as vital in the curricula in most of the country not only for academic success but also for its efficient application in everyday life. The study aimed to determine a significant relationship between the student, teacher, environmental, and parent involvement factors and students' mathematics performance in a Catholic university for the Academic Year 2020-2021. Also, it determined which factors predict the mathematics performance of students. Using descriptive-correlational research design, 123 Grade 8 students answered a researcher-made test questionnaire to assess students' level of mathematics performance; these were interpreted using the Department of Education's scale of standard. Furthermore, a researcher-made survey questionnaire was used to examine the level of extent of the four factors influencing the students' mathematics performance, the correlation between these factors and students' mathematics performance, and predictors of students' mathematics performance. The assembled information was dealt with measurably utilizing mean, standard deviation, Kruskal-Wallis, Pearson product-moment correlation, Spearman's rho, and multiple linear regression. Results revealed that students' level of mathematics performance was fairly-satisfactory ($M=79.77$, $SD=8.96$). The extent of influence of the factors is moderate ($M=3.28$, $SD=0.33$). There is a significant correlation between the extent of influence of factors as a whole and Mathematics performance [$r(121)=0.235$, $p=0.009$]. The results of the regression indicated that the predictor explained 7.3% of the variance [$F(1, 121)=9.540$, $p=0.002$, $R^2=0.073$]. The individual predictors were further examined and indicated that the teacher factor [$\beta=6.440$, $t=3.089$, $p=0.002$] significantly predicts

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Mathematics performance. This study provides significant insights into the vital role teachers play in finding a lasting solution to the students' perennial poor performance issues in mathematics in this new normal.

Keywords: Education; Mathematics performance; predictors; student factor; teacher factor; environmental factor; parent's involvement factor; descriptive-correlational.

1 Introduction

Mathematics performance has been recognized as vital in the curricula in most of the country not only for academic success but also for its efficient application in everyday life [1]. It receives attention frequently because it is regarded as a key topic that is crucial for the expansion and development of the country [2]. Not much information on best practices was available to guide such an abrupt shift from face-to-face classes to remote and online learning; COVID-19 brings an additional problem to different countries, specifically in dealing with students' mathematics performance [3].

The role of the private primary education institutions in the Philippines is vital in educating the minds of young Filipinos in terms of quality services; in contrast, results showed that students' performance was lower than the expected level in standardized national and even international assessments [4]. The country ranked last in Trends in International Mathematics and Science Study (TIMSS) 2019 [5]. The Department of Education reported that in the National Achievement Test, the mean percentage score of students was below the average. In the 2019 data of the Global Competitiveness Report of the World Economic Forum, the country ranked 64th of 141 participating countries in the quality of mathematics education and below the average of participating OECD countries based on the Programme for International Student Assessment (PISA) [6].

PISA 2018 revealed that Region VI ranked 7th out of 16 regions in the Philippines with a mean average score of 349. According to the report for School Year 2020-2021 in a Catholic university, an alarming result showed that 27.88% of the Grade 8 students mathematics performance was fairly satisfactory. It was further supported by the Global Resources for Assessment Curriculum and Evaluation [7], which revealed that 67.88 percent of students in high school were in the developing stage with a 20%-39% level of proficiency. As the university's vision is to provide quality education with a passion for excellence and maintain its standard, specifically in mathematics, studying the different factors predicting students' performance in mathematics is essential.

Recent studies on factors that influence the mathematics performance of students in the new normal delved more into student factors focusing on self-efficacy (Flores, 2021), the physical environment of students [8], and teacher factors [9]. So far, there has never been any attempt to study the four factors, namely, student factor, teacher factor, environmental factor, and parents' support, which influence students' mathematics performance in the new normal. Furthermore, it was encouraged that different areas related to students' mathematics performance during the new normal be explored [10].

Hence, this study primarily intended to find out the factors predicting the mathematics performance of Grade 8 students in the new normal in terms of student, teacher, environmental, and parents' involvement factors. Given the dearth of studies focusing on factors predicting students' mathematics performance, this study provides significant insights into the vital role played by teachers in finding a lasting solution to the perennial poor performance issues in mathematics of the students in this new normal. In addition, the results of the study provided empirical data that served as a basis for creating instructional material to help and improve students' mathematics performance and serve as an "eye-opener" for the department in investing efforts in the development of their teachers and formulate solutions to enhance the standard of students specifically in mathematics.

1.1 Statement of the problem

The proposed study aimed to determine the extent of influence of factors affecting the performance in Mathematics of Grade 8 students in the new normal for the academic year 2021-2022 when taken as a whole

and grouped according to sex and presence of an educational assistant. Likewise, it assessed the level of Mathematics performance of students.

Specifically, it answered the following research questions:

1. Is there a significant relationship between the extent of influence of factors and Mathematics performance?
2. Is there a significant relationship between the extent of influence of student, teacher, parents' involvement, and environmental factors and Mathematics performance?
3. Do these factors predict mathematics performance?

1.2 Hypothesis

1. There is no significant relationship between the extent of influence of factors and Mathematics performance.
2. There is no significant relationship between the extent of influence of student, teacher, parents' involvement, and environmental factors and Mathematics performance.
3. The factors mentioned above do not predict Mathematics performance.

2 Materials and Methods

2.1 Research design

The study utilized a descriptive-correlational research design. According to Garinganao [11], descriptive research involves gathering data to obtain necessary facts and information relative to identified variables. A correlational study is defined as a quantitative method of research. The researcher had two or more quantitative variables from the same group of subjects. The primary goal of this type of study was to explore the relationship between the different factors and the mathematics performance of students in the new normal [12]. Furthermore, the researcher used a multiple regression process to explore the relationship between predictive variables related to the dependent variable in this study of student academic performance [13].

2.2 Respondents

The respondents of this study were the 123 Grade 8 students in a private Catholic school for the academic year 2021-2022, chosen using stratified random sampling. The basis of stratification is the section of the students.

Table 1. Demographic profile of the respondents

Section	N	N	%
A	34	30	24.39
B	35	30	24.39
C	36	31	25.20
D	37	32	26.02
As a Whole	180	123	100%

2.3 Research instrument

A two-part researcher-made survey questionnaire was utilized to gather the data. Part 1 of the instrument determined the profile of the participants, and Part 2 of the instrument was used to measure the level of influence of the different factors that affect students' performance in mathematics. Since the instrument was researcher-made, it was subjected to validity by 10 panels of experts on the behavior and actions of students through the Content Validity Ratio (CVR), which garnered a content validity index of 0.90. Afterward, the item analysis and reliability test followed and yielded a Cronbach's Alpha value of 0.923. The mean range of the overall scores was interpreted and described using the following scales:

Chart 1. Scale of interpretation for the extent of influence

Scale	Mean	Interpretation
5	4.21 – 5.00	Very High Extent
4	3.41 – 4.20	High Extent
3	2.61 – 3.40	Moderate Extent
2	1.81 – 2.60	Low Extent
1	1.00 – 1.80	Very Low Extent

Furthermore, a separate researcher-made test questionnaire was administered to the students to measure their mathematics performance. The test questionnaire was aligned to the DepEd MELC's 2020, and items were distributed utilizing a Table of Specifications. To ensure the validity of the test questionnaire, these were subjected to an evaluation by seven experts in the chosen field of specialization using the Content Validity Ratio (CVR), which garnered a validity score of 0.90. After this, the item analysis and reliability test followed and yielded a Kuder-Richardson 20 (KR 20) of 0.754. The mean range of the overall scores was interpreted and described using the following scales:

Chart 2. Scale of interpretation for the math performance

Mean score range	Interpretation
90 – 100	Outstanding
85 – 89	Very Satisfactory
80 – 84	Satisfactory
75 – 79	Fairly Satisfactory
Below 75	Did Not Meet Expectations

Note: Based on DepEd Order no. 8, s.2015

Mean was used to determine the extent of the influence of the factors that affect the mathematics performance in the new normal of Grade 8 students when taken as a whole and in the areas of student factors, teacher factors, parents' involvement, and environmental factors. Also, the mean was used to determine the level of mathematics performance of the Grade 8 students when taken as a whole and grouped according to sex and the presence of an educational assistant.

2.4 Data collection procedure

An official letter noted by the research adviser and the dean of the Recoletos de Bacolod Graduate School seeking/asking permission to administer the test questionnaires to the respondents was sent to the principal. Before administering the instrument, respondents were given an orientation about the purpose and scope of the study, and they were asked to signify their willingness to participate in the study. After this, the survey and test questionnaires were encoded in the Google form and Learning Management System Platform, respectively, to be administered to the respondents.

Then, the researcher personally administered the test questionnaire first, followed by the survey questionnaire to the respondents during their math classes or any vacant time utilizing Zoom as an online platform. The researcher strictly imposed a time limit in taking the survey to avoid time constraints, and a grace period for finalization and submission of answers was also given. The researcher thoroughly explained ambiguous terms to ensure no misconceptions or misunderstandings in the test questionnaires.

After the data gathering, the data were tabulated and analyzed using the appropriate statistical tools.

2.5 Data analysis procedure

Kolmogorov-Smirnov normality test revealed that the variables mathematics performance, student factor, environmental factor, and influence, in general, were normally distributed. In contrast, the teacher factor and parent involvement factor were not normally distributed. Pearson product-moment correlation was used to determine the significant correlation between the extent of influence of factors and mathematics performance,

the extent of influence of student and environmental factors, and mathematics performance. Meanwhile, Spearman rank correlation was used to determine the significant correlation between the extent of influence of teacher and parents' involvement factor and the mathematics performance of Grade 8 students in the new normal. In addition, multiple linear regression was utilized to predict the factors influencing students' mathematics performance.

3 Results and Discussion

3.1 Profile of the respondents

This section presents the demographics of the Grade 8 students in a Catholic university. In terms of sex, 49.6% are male (n=61), and 50.4% are female (n=62). On the other hand, in terms of the presence of an educational assistant, 58.5% of participants had an educational assistant, while 41.5 % did not have an educational assistant.

Table 2. Demographic profile of the respondents

Variable	f	%
Sex		
Male	61	49.6
Female	62	50.4
Educational Assistant		
With Educational Assistant	72	58.5
Without Educational Assistant	51	41.5
Total	123	100.0

3.2 Level of mathematics performance

Table 2 presents the level of mathematics performance of Grade 8 students in the new normal based on the researcher-made test questionnaire. The level of mathematics performance as a whole (M=79.77, SD=8.96) is fairly satisfactory. When grouped according to sex, both male (M=79.95, SD= 9.07) and female (M=79.60, SD=8.91) students' level of mathematics performance is fairly satisfactory. When grouped according to the presence of an educational assistant, students with an educational assistant (M=79.32, SD=9.42) were fairly satisfactory, while students without an educational assistant (M=80.41, SD=8.30) were satisfactory.

Based on the outcome, it is understood that students have not fully absorbed and mastered the needed competencies during their previous year level. Problems about learning mathematics need to be addressed and improved, mainly because they were already assessed on the basic mathematical content, yet their performance was still unsatisfactory. Most respondents had a low performance, which is not a good sign concerning the teaching-learning process. This implies that students learned the basic mathematical concepts below the minimal level.

Moreover, a satisfactory level of students' mathematics performance without the presence of an educational assistant is an indication that they are self-directed learners. Students set for themselves a clear goal, take the initiative, are open and motivated, and are confident in handling the subject on their own. In contrast, a fairly-satisfactory level of students' mathematics performance with an educational assistant can be a representation of knowing that they are not well-motivated, lack confidence, and want to strengthen their comprehension of the subject matter. Hence, the educational assistant gives students individualized attention and helps them keep up in learning mathematics and improve their performance.

The result of this study may confirm the NAT, PISA, and TIMSS national and international assessment results in mathematics [9]. The low result of students' mathematics performance can be paralleled to the research result of Compayan and Dollete [14] that the basic math skills, including algebra, are under simplification. This means that attention should be paid to the issue, and corrective actions must be taken. In addition, the inverse relationship between the presence of an educational assistant and mathematics performance was discordant with Thurston et al. [15], indicating that mathematics performance was predicted by having a higher opinion of the

cognitive ability of students' educational assistants. Amid widespread school disruptions, there is a growing interest in intervention programs like tutorials as a solution to combat COVID-19 learning loss [16].

Table 3. Level of mathematics performance

Variable	M	SD	Interpretation
Sex			
Male	79.95	9.07	Fairly Satisfactory
Female	79.60	8.91	Fairly Satisfactory
Educational Assistant			
With Educational Assistant	79.32	9.42	Fairly Satisfactory
Without Educational Assistant	80.41	8.30	Satisfactory
Whole	79.77	8.96	Fairly Satisfactory

Mean Range: below 75=Did not meet Expectation, 75.00-79.99=Fairly Satisfactory, 80.00-84.99= Satisfactory, 85.00-89.99=Very Satisfactory, 90.00-100.00=Outstanding

Table 3 presents the extent of influence of the different factors, namely, student factors, teacher factors, environmental factors, and parent's involvement in the mathematics performance of Grade 8 students in the new normal. The extent of influence, when taken as a whole (M=3.28, SD=0.33), is moderate. The extent of influence as a whole and when grouped according to sex and presence of an educational assistant of student factors (M=3.19, SD=0.37), parents' involvement (M=3.19, SD=0.37), and environmental factor (M=3.19, SD=0.37) is moderate. However, the extent of influence of teacher factors (M=3.45, SD=0.38) when taken as a whole and when grouped according to sex and educational assistant is high.

One of the findings is that the teacher factor is very crucial to the mathematics performance of students. It reveals that to impact students' mathematics performance, the learning environment must promote and motivate learners to learn. Students draw from the teacher's disposition to form their own attitude, which may affect their mathematics performance. Hence, students become active when a constructive and quality teacher-student relationship is created. The different teaching strategies and approaches, confidence, and motivation given to students greatly affect their mathematics performance.

The result confirms the study of Michael [17] that teachers' competency and effectiveness greatly influence the mathematics performance of the students. It was pointed out that to enable students to construct and develop their understanding and knowledge of the subject matter, teachers should provide meaningful and authentic learning activities. This shows that students recognize the efforts of the teacher in getting their interest through the presence of activities employed by the teachers [18]. Findings are also consistent with those of Odicka (2017) that there is a need to understand and assess the needs of learners, which will be the basis for designing and employing lessons of the teachers.

Moreover, the results show that student factors, including the arithmetic ability of students, attitude towards the subject, self-directed learning, and motivation and concentration of students, were related to their mathematics performance. High levels of willingness to solve mathematics problems and active resistance of learners determined students' achievements in the subject. The results show that students can perform better if the learning environment is conducive and free from any distractions. Increased parent involvement, understanding, and encouragement were significantly related to an increase in the mathematics performance of their students. The provisions of learning resources are further responsible for the performance of students.

This finding relates to the discovery of Peteros et al. [12], which reveals the influence of student factors on their performance. In addition, the lack of concentration which roots in the overuse of gadgets, also contributes to the poor performance of students [19]. The results of previous studies demonstrated that the increased and active involvement of parents towards the performance of their students is significantly related to a child's increased perception of cognitive competence [20,21]. Furthermore, the result means that the increase in perception of the learning environment would also likely improve the attitudes and performance of students in mathematics [18]. It agrees with Kudari [22] by acknowledging that the learning environment has influenced students' mathematics performance.

Table 4. Extent of influence of factors affecting the performance in mathematics of Grade 8

Variable	Student			Teacher			Parents' involvement			Environmental			Influence		
	M	SD	Int	M	SD	Int	M	SD	Int	M	SD	Int	M	SD	Int
Sex															
Male	3.16	0.36	ME	3.45	0.38	HE	3.29	0.40	ME	3.14	0.50	ME	3.26	0.33	ME
Female	3.23	0.38	ME	3.48	0.37	HE	3.30	0.36	ME	3.16	0.57	ME	3.29	0.33	ME
Educational Assistant															
With Educational Assistant	3.20	0.38	ME	3.44	0.32	HE	3.27	0.35	ME	3.22	0.49	ME	3.28	0.30	ME
Without Educational Assistant	3.19	0.36	ME	3.50	0.45	HE	3.34	0.41	ME	3.05	0.58	ME	3.27	0.37	ME
Whole	3.19	0.37	ME	3.47	0.38	HE	3.30	0.38	ME	3.15	0.53	ME	3.28	0.33	ME

Mean Range: 1.00-1.80=Very Low Extent, 1.81-2.60=Low Extent, 2.61-3.40=Moderate Extent, 3.41-4.20=High Extent, 4.21-5.00=Very High Extent

3.3 Relationship between mathematics performance and the student, teacher, environmental, and parent's involvement factors

Pearson product-moment correlation was used to determine the significant correlation between the extent of influence of factors and mathematics performance, the extent of influence of student factors and environmental factors, and mathematics performance. Spearman rank correlation was used to determine the significant correlation between the extent of influence of teacher factors and parents' involvement factors and mathematics performance.

There is a significant correlation between extent of influence of factors as a whole and mathematics performance [$r(121)=0.235$, $p=0.009$], extent of influence of student factor [$r(121)=0.249$, $p=0.006$], teacher factor [$r_s(121)=0.270$, $p=0.002$], parents' involvement factor [$r_s(121)=0.209$, $p=0.021$] and mathematics performance. There is no significant relationship between the extent of influence of environmental factors and Mathematics performance [$r(121)=0.073$, $p=0.420$].

Based on the result, the enabling factors that have a significant relationship with the mathematics performance of students are observed to originate from a combination of different reasons. It indicates that teaching strategies and methods that best suit specific objectives and exit outcomes emerged as the most influential factor in the performance of students in mathematics. How teachers view mathematics, such as its usefulness in life and approaches to learning math, impacts the student's performance [23,24]. Teachers' commitment to teaching by lending extra help to students beyond their working hours, knowledge of the content, openness to suggestions, and being worthy of praise make students feel at ease in handling the subject. This means that teachers' active listening and encouragement and the provision of fun, supported, and challenging environments where students could learn and appreciate greatly affect their performance in mathematics.

The result presented should help the students and those interested in improving the teaching and learning process for the ultimate good of students' performance in mathematics [19]. The results agree with Enu et al. [25] that a teacher's method of instruction affects students' performance in mathematics. Significant research on the effectiveness of teaching methods and strategies indicates that the achievements of students often reflect the quality of teaching [10]. As such, the alignment of teaching methods and strategies with students' needs and preferred learning influences the performance of students in mathematics.

Results, amongst others, showed that student-related factors like lack of effort and self-confidence, insufficient motivation, learning preferences, poor study habits, accessibility and availability of learning resources, and many other factors contribute to their mathematics performance. It was also observed that the students' literacy abilities in understanding mathematics play an important factor in their performance. It was presumed that finding ways to develop students' study habits and confidence and reduce math anxiety can significantly improve students' mathematics performance [26,27].

It has been established that factors that affect the mathematics performance of students are related to aspects of students, teachers, and parents' involvement. These results affirm the study of Okoedion et al. [28] that these factors have a relatively significant effect on the mathematics performance of the students. The student's attitude is seen to have a relationship to their mathematics performance in many studies. A comparative study by Ribeiro et al. [29] and Emeke et al. [30] found a direct link between students' attitudes and mathematics performance. The findings are also steady with the discoveries of Peteros et al. [12] and Lagrimas [31], who found a significant relationship between student factors and mathematics performance of students.

Also, parents play a vital role in encouraging their children to pursue high educational goals and desires by providing the educational resources on hand in the home and holding attitudes and values towards their children's learning. Parents' dedication to supporting their school-related activities, monitoring students' work, understanding their children's strengths and weaknesses, motivation and recognition given to students, and their effort to understand math concepts influenced their child's mathematics performance [32,33]. Collectively, these results point out that attention should be given to the collaborative efforts and involvement of students, teachers, and parents to improve students' mathematics performance.

The high support and involvement of parents, the ability and quality of the teacher to teach the subject, and the different factors involving students play an important role in the mathematics performance of the respondents

(Abdullah et al. 2018). Moreover, these findings substantially support Capuno [34], Balolong and Decejo [35], and Khasawneh et al. [36]. Apart from the latter, the finding of Pardinim [37] also revealed that the role of parents in guiding and encouraging their children to pursue high performance in mathematics by establishing educational resources on hand at home and holding certain attitudes and values was paramount to the mathematics performance of students.

Table 5. Relationship between mathematics performance and the student, teacher, environmental, and parent’s involvement factors

Variable	R	df	P
Factors	0.235*	121	0.009
Students	0.249*	121	0.006
Environmental	0.073	121	0.420
Variable	r _s	df	P
Teacher	0.270*	121	0.002
Parent's Involvement	0.209*	121	0.021

Note: *relationship is significant when $p < 0.05$

3.4 Predictors of mathematics performance

Multiple linear regression was used to determine the factors that predict mathematics performance. Multiple linear regression indicated a significant predictor of factors on mathematics performance. The results of the regression indicated that the predictor explained 7.3% of the variance [$F(1, 121)=9.540, p=0.002, R^2=0.073$]. The individual predictors were further examined, indicating that the teacher factor [$\beta=6.440, t=3.089, p=0.002$] significantly predicts mathematics performance.

Based on the result, mathematics performance is accounted for by the teacher factors. The teacher's experience and knowledge of the subject are important indicators to involve students in meaningful and effective mathematical practices in learning. As a result, students can develop a deep understanding of mathematics. The ability to use different teaching strategies in dealing with mathematics and finding the best methods to present the content effectively facilitate successful learning. Hence, it is essential to identify the best methods, techniques, and strategies employed by the teachers, which will help future students to have better entry-level mathematics performance. Maintaining a good relationship with the students and being open to some questions and clarification are vital for teachers to develop the student's sense of encouragement which results in the improvement of their mathematics performance.

Table 6. Predictors of mathematics performance

R	R ²	f	df	p
0.270	0.073	9.540	1, 121	0.002
Variables	Beta	t	p	
(Constant)	57.445	7.901	0.000	
Teacher	6.440*	3.089	0.002	
Student	0.146	1.417	0.159	
Parent’s Involvement	0.064	0.571	0.569	
Environmental	-2.074	-0.742	0.460	

This supports the study of Sapalo [38] that teacher factors directly determined the academic performance of students. However, these results contradict those of Jardeleza et al. [39] and Lee and Kung [40], who found the distinction between student factors, learning environment, parents involved, and students' mathematics performance. Nevertheless, a harmonious relationship between the student and the teacher is an important means of developing students' performance. This agrees with the proposal of Valdez [41] that there is a need to craft a possible intervention program that would probably help teachers enhance students' relationships with them and improve students' performance in the subject.

Based on the findings of the study, student, teacher, and parents' involvement factors affect the mathematics performance of students. Among these factors, student-teacher interaction and quality of instruction domain reflected in teacher factor greatly affect the performance of students in mathematics. In the light of the theoretical framework of Walberg [42], different educational productivity factors were hypothesized to operate vis-à-vis a complex set of interactions to account for the academic performance of the students; hence, the Theory of Educational Productivity was validated by the result of this study. Thus, the quality and quantity of teaching can improve students' mathematics performance, which requires the teacher's motivation, support, and strategies.

4 Conclusion

With the result showing the poor mathematics performance of Grade 8 students, there is an arising difficulty for the succeeding grade level teacher to implement the concept of spiral progression in mathematics. That is to present concepts with a deepening layer of complexity resulting from the student's failure to absorb the basics of mathematics. Teachers should ensure that the students have developed their mastery of the basic mathematical concepts so that it would be easy for them to transition from simple to complex lessons through drills and interactive and student-centered teaching approaches. Therefore, an emphasis on prerequisite skills should be given importance; hence, quality is still better than quantity in terms of teaching mathematics. Teachers need to develop good relationships with the students and improve classroom activities that involve an active teaching-learning process, student participation, and engagement to ensure that learning can be fruitful and meaningful. Therefore, teachers' support and encouragement in developing their students' ability to solve problems, reason logically, and apply their learnings in real life are vital for improving their mathematics performance.

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Ethical Approval

The researcher addressed the general ethical principles of respect for persons, beneficence, and justice to ensure the ethical soundness of the study.

Competing Interests

Authors have declared that no competing interests exist.

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