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Determinants of mathematics achievement in modular distance learning: A predictive modeling study among secondary students

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Abstract

The study examined the determinants of mathematics achievement in Modular Distance Learning (MDL) among secondary students and developed a predictive model for mathematics performance. A total of 353 students participated in the study using a validated questionnaire that measured demographic characteristics, technology-related factors, prior mathematics achievement, and perceived learning experiences in MDL. Descriptive statistics and multiple regression analysis were employed to analyze the data. Findings revealed that mathematics performance significantly declined during MDL compared to traditional face-to-face learning. Previous mathematics achievement, perceived learning experience, age, and grade level were identified as significant predictors of mathematics performance. The predictive model generated was: MDL Mathematics Performance = 47.95 + (0.374 × previous mathematics achievement) + (0.602 × perceived learning experience) − (0.256 × age) + (0.756 × grade level). In contrast, gender, parental educational background, household income, internet accessibility, technology use, and internet connectivity were not significant predictors. The study provides empirical evidence that may guide educators, school administrators, and policymakers in designing interventions, improving support, and enhancing mathematics learning outcomes among students engaged in alternative learning delivery modalities during disruptions.

Keywords: Learning experiences, Math performance, Modular distance learning, Pandemic, Predictors, Secondary students, Predictive modeling.

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Transparency: The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
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Contents

Contribution of this paper to the literature

This study contributes to the existing literature by identifying significant predictors of mathematics achievement in modular distance learning among secondary students. The paper's primary contribution is finding that prior mathematics achievement and learning experiences significantly influence MDL performance and may guide educators in improving mathematics instruction during alternative learning delivery.

1. Introduction

The COVID-19 pandemic significantly disrupted educational systems worldwide, forcing schools to adopt alternative learning modalities to ensure continuity of instruction (Aucejo, French, Araya, & Zafar, 2020; Rasmitadila et al., 2020). In the Philippines, the Department of Education (DepEd) implemented the Basic Education Learning Continuity Plan (BE-LCP), which introduced several distance learning modalities, including Modular Distance Learning (MDL), as stated in (DepEd Order No. 012, 2020). MDL became one of the most widely implemented learning approaches, especially in areas with limited internet connectivity and inadequate access to digital technologies. Through this modality, students learned independently using printed self-learning modules with guidance from teachers and parents.

Mathematics education became a major concern during the implementation of MDL because mathematics requires continuous interaction, guided instruction, and immediate feedback to support conceptual understanding and problem-solving skills. Even before the pandemic, international assessments such as the Programme for International Student Assessment (PISA) consistently reported low mathematics performance among Filipino learners. The sudden shift from face-to-face classes to modular learning further intensified existing difficulties in mathematics, especially among students with limited academic support and learning resources at home.

Recent empirical studies have identified both advantages and challenges associated with MDL. Studies reveal that modular learning promotes independent learning, self-regulation, and learner responsibility (Ambayon, 2020; Anzaldo, 2021). Likewise, parental involvement and flexible pacing support students' engagement in learning (Olivo, 2021). However, several studies also document major difficulties encountered by learners, including poor time management, insufficient parental assistance, limited instructional support, inadequate learning resources, and difficulty understanding lessons independently (Dangle & Sumaoang, 2020; Trovela, 2021). In mathematics, these challenges may negatively affect students' academic performance because many mathematical concepts require guided explanation and continuous practice.

Previous studies have also shown that students' academic performance is influenced by various demographic, socio-economic, technological, and educational factors. Variables such as prior academic achievement, socioeconomic status, parental educational background, access to technology, internet connectivity, and students' learning experiences have been associated with academic success in mathematics (Capinding, 2021; Musso, Kyndt, Cascallar, & Dochy, 2012; Suárez-Álvarez, Fernández-Alonso, & Muñiz, 2014). Moreover, research suggests that prior academic achievement remains one of the strongest predictors of future academic performance (Heyder, Kessels, & Steinmayr, 2017; Li, Chen, & Duanmu, 2010).

Despite the growing body of literature on distance learning during the pandemic, limited studies have specifically examined the combined influence of learner characteristics, technology-related factors, and perceived learning experiences on mathematics achievement within the context of modular distance learning in Philippine secondary schools. Most previous studies focused either on online learning environments or on the general implementation challenges of MDL without developing predictive models of mathematics achievement. Furthermore, there remains limited empirical evidence identifying which factors significantly predict students' mathematics performance in MDL settings.

To address this gap, the present study investigated the determinants of mathematics achievement among secondary students engaged in modular distance learning. Specifically, the study examined the extent to which demographic characteristics, socio-economic conditions, technology-related variables, previous mathematics achievement, and perceived learning experiences predict students' mathematics performance in MDL. The study also developed a predictive model that may provide useful evidence for educators, school administrators, and policymakers in designing interventions and support mechanisms to improve mathematics learning outcomes in alternative learning modalities.

2. Review of Related Literature

2.1. Modular Distance Learning and Mathematics Education

Modular Distance Learning (MDL) emerged as one of the primary alternative learning modalities implemented during the COVID-19 pandemic, especially in developing countries where access to stable internet connectivity and digital technologies remained limited. In the Philippine context, MDL relied heavily on printed self-learning modules that allowed students to continue their education independently at home under the supervision of parents or guardians. The modality was designed to ensure learning continuity despite mobility restrictions and school closures imposed during the pandemic.

Existing studies present mixed findings regarding the effectiveness of MDL in supporting students' academic achievement. Several researchers argue that modular learning promotes learner autonomy, self-regulation, and responsibility for learning (Ambayon, 2020; Anzaldo, 2021). Students are given opportunities to manage their own learning pace and develop independent study habits, which are considered important lifelong learning skills. Similarly, Olivo (2021) emphasized that MDL increased parental participation in the learning process because parents became more directly involved in monitoring and assisting students at home. Such involvement may positively influence students' motivation and engagement.

However, despite these potential benefits, many empirical studies also documented substantial challenges associated with MDL implementation. Dangle and Sumaoang (2020) found that students frequently experienced difficulty understanding lessons independently due to limited teacher interaction and insufficient academic support at home. Trovela (2021) further noted that students encountered problems related to time management, low

motivation, and inadequate learning resources. These challenges become more critical in mathematics education because mathematical learning often requires guided explanation, immediate feedback, and continuous practice to develop conceptual understanding and procedural fluency.

The literature further suggests that the effectiveness of MDL varies depending on contextual and learner-related factors. While some students benefit from the flexibility and independence provided by modular learning, others struggle because of disparities in access to educational support, technology, and learning resources. Consequently, the effectiveness of MDL cannot be generalized across all learners and educational contexts. This highlights the importance of examining the determinants of mathematics achievement within modular learning environments, particularly among students from varying socio-economic and educational backgrounds.

2.2. Demographic and Socio-Economic Factors Associated with Mathematics Achievement

Academic achievement in mathematics has long been associated with demographic and socio-economic characteristics of learners. Previous studies consistently indicate that age, gender, socio-economic status, parental educational background, and prior academic achievement influence students' academic outcomes, although findings remain inconsistent across contexts. Age has been identified as a potential predictor of academic performance because maturity may affect students' motivation, learning behaviors, and self-regulation skills. Saka (2021) argued that older students may demonstrate greater academic responsibility and persistence in learning tasks. However, other studies reported contrasting findings, suggesting that younger learners may adapt more effectively to flexible learning modalities due to higher motivation and cognitive readiness (Capinding, 2021). These inconsistent findings imply that the relationship between age and mathematics achievement may depend on learning context and instructional modality. Gender differences in mathematics achievement remain inconclusive in the literature. Some studies found that female students perform better in distance learning settings because they tend to exhibit stronger organizational skills, greater academic discipline, and better time management behaviors (McSporran & Young, 2001; Price, 2006). In contrast, other studies reported minimal or statistically insignificant differences between male and female students in mathematics achievement (Reyes, 2021). These varying results suggest that gender alone may not directly determine mathematics performance but may interact with other motivational and environmental factors. Socio-economic status (SES) is another frequently examined determinant of academic achievement. Learners from higher-income families generally have greater access to educational resources, learning technologies, and supportive learning environments, which may positively affect academic outcomes (Considine & Zappalà, 2002). During the pandemic, disparities in SES became more pronounced because economically disadvantaged students often lacked adequate learning materials, internet access, and parental academic support (Daguno-Bersamina & Relativo, 2020). Nonetheless, some studies suggest that SES may not always directly predict academic performance once other variables, such as motivation and prior achievement, are considered. This indicates that the influence of SES may be mediated by multiple educational and psychological factors.

Parental educational background has also been linked to students' mathematics achievement. Capinding (2021) and Kunwar (2020) reported that students whose parents attained higher levels of education generally receive greater academic guidance and encouragement at home. Educated parents are more likely to assist learners in completing academic tasks and monitoring their progress. However, the extent of parental influence may vary depending on parental involvement, availability, and familiarity with the subject matter. In modular learning environments, parental educational background may become particularly important because parents often function as learning facilitators in the absence of regular teacher interaction.

Collectively, these studies indicate that demographic and socio-economic variables may influence mathematics achievement through complex and interrelated mechanisms. However, existing findings remain inconsistent across learning contexts, emphasizing the need for further investigation in modular distance learning environments.

2.3. Technology-Related Factors and Mathematics Performance

Technology access and connectivity became critical concerns during the implementation of distance learning modalities. Several studies emphasized that students' access to digital devices, internet connectivity, and technological resources significantly affect participation and academic engagement in remote learning environments (Kennedy, 2010; Nawaz & Amin, 2018). Research indicates that students with stable internet access and sufficient technological resources are more likely to access supplementary learning materials, communicate effectively with teachers, and engage in academic activities (Maqableh, Jaradat, & Azzam, 2021). Furthermore, digital literacy and technology integration were found to enhance students' critical thinking and mathematical problem-solving skills (Moreno-Guerrero, López-Belmonte, Romero-Rodríguez, & Rodríguez-García, 2020). These findings suggest that technology can facilitate improved learning experiences and academic achievement when effectively utilized. However, the relationship between technology use and mathematics achievement is not consistently positive. Wang (2021) argued that excessive reliance on technology does not necessarily improve academic performance and may even distract students from learning tasks. Similarly, Panthi, Acharya, Kshetree, Khanal, and Belbase (2021) noted that technological resources alone cannot guarantee meaningful mathematics learning if instructional quality and learner engagement remain inadequate. These findings imply that the educational value of technology depends not only on availability but also on how technology is integrated into the learning process. In the Philippine context, many students experienced unstable internet connectivity and limited access to technological devices during the pandemic, particularly in rural and low-income communities. Such disparities may contribute to unequal learning opportunities and differences in academic performance among students engaged in MDL. Despite these challenges, empirical evidence examining the direct influence of technology-related variables on mathematics achievement within modular distance learning remains limited.

2.4. Students' Learning Experiences and Mathematics Achievement

Students' learning experiences significantly influence academic performance, especially in alternative learning modalities. These experiences include perceptions of instructional delivery, access to learning materials, assessment processes, and overall satisfaction with the learning environment.

Research suggests that positive learning experiences are associated with higher academic motivation, engagement, and achievement. Robert and Sampson (2011, as cited in Singh, Malik, and Singh (2016)) emphasized that students who actively engage in the learning process generally demonstrate better academic outcomes. In mathematics education, well-designed instructional modules can improve students' conceptual understanding, problem-solving skills, and learning motivation (Madrazo & Dio, 2020; Putri, Ferdianto, & Fauji, 2020).

Conversely, negative learning experiences may hinder academic performance. Students who experience difficulty understanding instructional materials, limited interaction with teachers, and inadequate academic support are more likely to develop frustration and low motivation toward mathematics learning. Dangle and Sumaoang (2020) observed that many students struggled with self-directed learning during the implementation of MDL because they lacked immediate feedback and clarification from teachers. These findings highlight the importance of examining students' perceptions and experiences in understanding mathematics achievement within modular learning settings.

Although previous studies have investigated various factors associated with mathematics achievement, much of the existing literature focuses either on traditional classroom instruction or online learning environments. Limited research has comprehensively examined the combined influence of demographic characteristics, socio-economic conditions, technology-related variables, and perceived learning experiences on mathematics achievement in modular distance learning. Moreover, few studies have developed predictive models capable of identifying the most significant determinants of students' mathematics performance in MDL contexts.

Therefore, the present study addresses this gap by examining the predictors of mathematics achievement among secondary students engaged in modular distance learning and by developing a predictive model based on learner characteristics and educational experiences.

3. Methodology

3.1. Research Design

This study employed a quantitative research design using a descriptive-correlational approach. The descriptive component was used to describe the demographic characteristics, technology-related factors, perceived learning experiences, and mathematics performance of respondents in the context of Modular Distance Learning (MDL). The correlational component examined the relationships among the independent variables and their predictive influence on students' mathematics achievement. Furthermore, multiple regression analysis was employed to develop a predictive model for mathematics performance in MDL.

The descriptive-correlational design was considered appropriate because the study aimed not only to describe students' experiences and profiles but also to determine the extent to which selected variables significantly predict mathematics achievement in modular distance learning environments.

3.2. Participants and Research Context

This study was conducted at Montpellier National High School, a public secondary school under the Department of Education located in Alegria District, Cebu, Philippines. The school implemented Modular Distance Learning (MDL) during the COVID-19 pandemic as part of the Department of Education's Basic Education Learning Continuity Plan for School Year 2020–2021.

The participants of the study consisted of all Grade 7 to Grade 11 students enrolled at Montpellier National High School during the school year 2020–2021. A total of 353 students participated in the study. The respondents represented learners from diverse socio-economic and educational backgrounds, including students from rural and low-income communities with varying levels of access to technology and internet connectivity. These contextual conditions provided an appropriate setting for examining the determinants of mathematics achievement in modular distance learning.

Participation in the study was voluntary. Informed consent was obtained from the participants and their parents or guardians before data collection. Ethical considerations, including confidentiality, anonymity, and proper data handling, were strictly observed throughout the study's conduct.

3.3. Research Instrument

The study utilized a modified survey questionnaire adapted from Misko (2000) to gather data regarding students' perceived learning experiences in Mathematics under Modular Distance Learning (MDL), along with their demographic and academic information. The questionnaire was translated into Cebuano to ensure better comprehension among respondents and improve response accuracy.

The instrument consisted of two major sections. The first section gathered respondents' demographic, socio-economic, and technology-related information, including age, gender, grade level, previous Mathematics grade, household income, parents' educational background, internet accessibility, availability of technological devices, and internet connectivity.

The second section measured students' perceived learning experiences in Mathematics under MDL using a five-point Likert scale with categories: Strongly Disagree (1), Disagree (2), Maybe (3), Agree (4), and Strongly Agree (5). It included 25 items categorized into five operational dimensions:

1. Problems and Concerns: Assessed students' perceived challenges and personal difficulties encountered in modular learning, including time management, study discipline, workload, and completion of Mathematics tasks and assignments.
2. Ease of Access: Measured the accessibility of learning resources, printed modules, teacher communication, reference materials, and other instructional supports needed for Mathematics learning.
3. Evaluation: Examined students' perceptions regarding the clarity, comprehensibility, and practicality of instructions, study guides, assessments, and activities included in the mathematics modules.
4. Delivery: Assessed the effectiveness of the modules in facilitating understanding of mathematics concepts, supporting skill development, meeting course requirements, and providing access to instructional guidance.

5. Satisfaction: Measured students' overall satisfaction, motivation, engagement, and acceptance of modular learning as an instructional approach in Mathematics.

Each dimension contained five questionnaire items, resulting in a total of 25 indicators that measured students' learning experiences in modular distance learning.

3.4. Validity and Reliability of the Instrument

The modified questionnaire underwent content validation by three experts in Mathematics education and educational research to ensure the relevance, clarity, and appropriateness of the instrument items concerning the study's objectives. Revisions were incorporated based on the validators' recommendations.

To establish internal consistency reliability, a pilot test was conducted among students with characteristics similar to the actual respondents but who were not included in the final sample. Reliability analysis using Cronbach's alpha coefficient yielded values ranging from 0.722 to 0.734 across the five dimensions of the questionnaire, indicating acceptable reliability for research purposes. According to established standards, Cronbach's alpha coefficients above 0.70 indicate satisfactory internal consistency among questionnaire items.

3.5. Data Collection Procedure

Prior to data collection, permission to conduct the study was secured from the school administration of Montpelier National High School. After obtaining approval, the researcher coordinated with teachers and class advisers regarding the administration and retrieval of the survey questionnaires.

The questionnaires were distributed to respondents during the implementation of Modular Distance Learning. Students and parents or guardians were informed about the study's purpose, voluntary participation, and response confidentiality. Completed questionnaires were retrieved, checked for completeness, encoded, and organized for statistical analysis.

3.6. Data Analysis

Descriptive statistics, including frequency counts, percentages, weighted means, and standard deviations, were used to describe respondents' demographic characteristics, technology-related factors, perceived learning experiences, and mathematics performance.

To determine the predictors of students' mathematics achievement in MDL, multiple linear regression analysis was employed. The dependent variable was students' mathematics performance, while the independent variables included demographic characteristics, socio-economic factors, technology-related aspects, previous mathematics achievement, and perceived learning experiences.

The regression model used in the study is expressed as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_n X_n + \varepsilon \quad (1)$$

Where:

- Y represents students' mathematics performance in MDL.
- β_0 represents the intercept.
- $\beta_1, \beta_2, \beta_3, \ldots, \beta_n$ represent the regression coefficients.
- $X_1, X_2, X_3, \ldots, X_n$ represent the independent variables.
- ε represents the error term.

All statistical analyses were conducted at a 0.05 level of significance to determine whether the independent variables significantly predicted mathematics achievement in modular distance learning.

4. Results

4.1. Students' Profile

This section presents the demographic and technology-related characteristics of respondents, including age, gender, grade level, socio-economic status, parental educational background, internet accessibility, availability of technological devices, and internet connectivity during the implementation of Modular Distance Learning (MDL).

Table 1. Students' personal profile.

Profile variables	Frequency	Percentage
Age		
12-13	84	23.80
14-15	102	28.90
16-17	111	31.44
18 & above	56	15.86
Gender		
Male	170	48.16
Female	183	51.84
Grade level		
Grade 7	107	30.31
Grade 8	89	25.21
Grade 9	56	15.86
Grade 10	49	13.88
Grade 11	52	14.73
Socio-Economic Status		
P2,000-P4,999	270	76.49
P5,000-P9,999	32	9.07
P10,000-P15,999	38	10.76

Profile variables	Frequency	Percentage
P16,000-P20,999	3	0.85
P21,000 above	10	2.83
Mother's educational background		
College graduate	9	2.55
College level	11	3.12
High school graduate	37	10.48
High school level	64	18.13
Elementary graduate	87	24.65
Elementary level	140	39.66
None	5	1.42
Fathers' educational background		
College graduate	6	1.70
College level	14	3.97
High school graduate	24	6.80
High school level	44	12.46
Elementary graduate	99	28.05
Elementary level	153	43.34
None	13	3.68
Total	353	100

Table 1 presents the demographic characteristics of the respondents. Among the 353 participants, the majority were between 16–17 years old (31.44%), followed by those aged 14–15 years old (28.90%). Female students comprised 51.84% of the respondents, while 48.16% were male. In terms of grade level, Grade 7 students represented the largest group (30.31%), followed by Grade 8 students (25.21%).

Regarding socio-economic status, most respondents belonged to low-income households, with 76.49% reporting a monthly family income ranging from Php 2,000 to Php 4,999. The educational backgrounds of both parents also reflected relatively low educational attainment, as most parents had only reached the elementary level or elementary graduation.

Table 2. Students' profile related to technology.

Profile variable		
Internet accessibility	**f**	**Percentage**
WiFi	48	13.60
Hotspot	4	1.13
Broadband Internet	2	0.57
Mobile data	281	79.60
None	18	5.10
Availability of technology		
Smartphones	311	88.10
Laptop	2	0.57
Personal computer	2	0.57
iPad/Tablet	8	2.27
Others	5	1.42
2 gadgets	5	1.42
None	20	5.67
Internet connection		
Poor	250	70.82
Average	63	17.85
Strong	22	6.23
None	18	5.10
Total	353	100

Table 2 presents the technology-related profile of the respondents. Results reveal that 79.60% of students relied primarily on mobile data for internet access, while only 13.60% had access to Wi-Fi. Smartphones were the most used device (88.10%). Additionally, 70.82% of respondents reported experiencing poor internet connectivity during modular distance learning.

These findings indicate that respondents experienced limited technological resources and unstable internet access during MDL implementation, which may have affected their learning experiences and academic engagement in Mathematics.

4.2. Perceived Learning Experiences of Students on the Use of Modular Distance Learning Experience

Table 3 presents respondents' perceived learning experiences in Mathematics under Modular Distance Learning across five dimensions: problems and concerns, ease of access, evaluation, delivery, and satisfaction.

Table 3. Students' Experiences and Perception Level on the Use of Modular Distance Learning.

Variables	WM	SD
Problems and concerns	3.57	0.75
Ease of Access	3.57	0.77
Evaluation	3.37	0.71
Delivery	3.71	0.73
Satisfaction	3.54	0.73
Composite mean	3.55	0.58

The composite mean of 3.55 (SD = 0.58) indicates that students generally had moderately positive learning experiences in MDL. Among the dimensions, delivery obtained the highest weighted mean (WM = 3.71, SD = 0.73), suggesting that students perceived the modules as relatively effective in facilitating mathematics learning and course completion. Evaluation also received favorable responses, indicating that most respondents found the instructions and assessment activities understandable and manageable.

On the other hand, problems and concerns obtained a mean score of 3.57 (SD = 0.75), indicating that students still encountered certain difficulties while studying independently through modules. Similarly, satisfaction registered a mean of 3.54 (SD = 0.73), implying that although students generally accepted modular learning, some remained uncertain regarding its effectiveness and overall learning experience.

Overall, the findings suggest that while students demonstrated moderate acceptance of modular distance learning, challenges associated with independent learning and limited instructional support remained evident.

4.3. Students' Learning Performances in Mathematics

Figure 1 compares students' Mathematics performance before and during the implementation of Modular Distance Learning. Results revealed that students performed better during traditional face-to-face instruction compared to MDL.

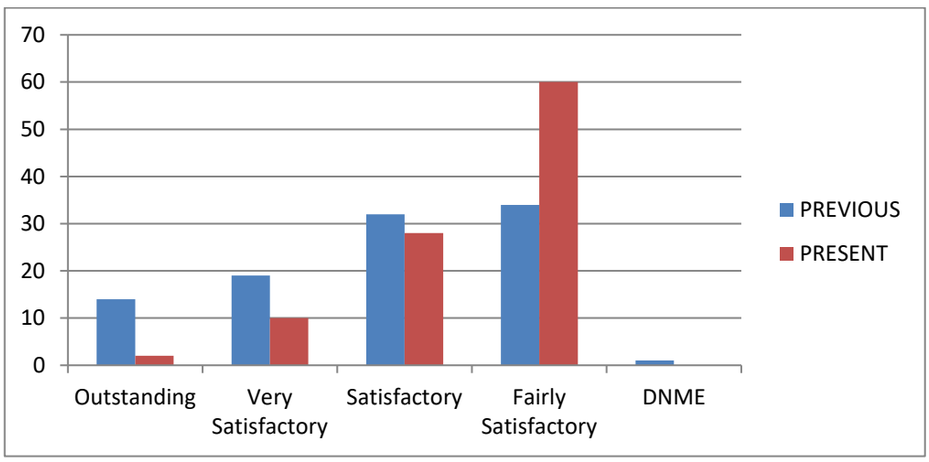

Figure 1. Students' learning performance level in mathematics during face-to-face and MDL.

The respondents obtained an average Mathematics grade of 82.33 during face-to-face learning, which falls under the "Satisfactory" level. In contrast, the average Mathematics grade during MDL decreased to 79.54, classified as "Fairly Satisfactory." Furthermore, a larger proportion of students obtained "Outstanding" and "Very Satisfactory" ratings during face-to-face instruction than during MDL.

The findings indicate a decline in Mathematics performance during modular distance learning, suggesting that students experienced greater academic difficulty under the alternative learning modality.

4.4. Regression Analysis Results Among the Profile Parameters, Learning Experiences, and Students' Mathematics Performance

Table 4 presents the results of the multiple regression analysis conducted to determine the predictors of students' mathematics performance in modular distance learning.

Table 4. Results of regression analysis.

Parameters	Unstandardized coefficients		Standardized coefficients	t	P-Value
	B	Std. error	Beta		
(Constant)	47.954	3.431		13.976	<0.001
Previous grade in math	0.374	0.036	0.513	10.404	<0.001
Students' experience in MDL	0.602	0.297	0.091	2.026	0.044
Age	-0.256	0.123	-0.148	-2.084	0.038
Grade level	0.756	0.191	0.279	3.965	<0.001
Sex	0.409	0.385	0.053	1.061	0.289
Income	-0.280	0.498	-0.025	-0.562	0.575
Mothers' educational qualifications	0.086	0.375	0.010	0.228	0.820
Father's educational qualification	0.042	0.368	0.005	0.115	0.909
Internet accessibility	0.212	0.138	0.067	1.532	0.126
Technologies use	-0.837	0.662	-0.056	1.264	0.207
Internet connection	0.297	0.396	0.033	0.749	0.454

Note: Dependent variable: Student performance.

The regression model revealed that previous Mathematics grade, perceived learning experience, age, and grade level were statistically significant predictors of Mathematics performance in MDL. Specifically, previous Mathematics grade emerged as the strongest predictor ($\beta = 0.513, p < 0.001$), indicating that students with higher prior achievement in Mathematics were more likely to obtain higher Mathematics performance during modular learning.

Perceived learning experience was also found to be a significant positive predictor ($\beta = 0.091, p = 0.044$), suggesting that students who reported more favorable experiences in modular learning tended to perform better academically. Similarly, grade level significantly predicted Mathematics performance ($\beta = 0.279, p < 0.001$), implying that students in higher grade levels demonstrated relatively better academic performance in MDL.

In contrast, age showed a significant negative relationship with Mathematics performance ($\beta = -0.148, p = 0.038$), indicating that younger students tended to perform better than older students in the modular learning environment.

The regression model is expressed as:

$$\text{MDL Mathematics Performance} = 47.95 + 0.374(\text{Previous Mathematics Grade}) + 0.602(\text{Perceived Learning Experience}) - 0.256(\text{Age}) + 0.756(\text{Grade Level}) \quad (2)$$

The model yielded an R^2value of 0.377, indicating that approximately 37.7% of the variance in Mathematics performance in MDL can be explained by the identified predictors. Furthermore, the overall regression model was statistically significant ($F = 18.67, p < 0.001$), indicating that the independent variables collectively contributed significantly to predicting students' Mathematics achievement.

However, gender, household income, parental educational background, internet accessibility, availability of technology, and internet connectivity were not found to be statistically significant predictors of mathematics performance in MDL.

5. Discussion

The findings of the study demonstrate that students' prior academic achievement plays a critical role in predicting Mathematics performance in modular distance learning. Previous Mathematics grades emerged as the strongest predictor of academic performance, indicating that students with stronger foundational knowledge and prior competencies in Mathematics were more capable of adapting to independent learning conditions. This finding supports previous studies suggesting that prior academic achievement is one of the most reliable predictors of future academic success (Heyder et al., 2017; Li et al., 2010). The result also implies that students with stronger mathematical foundations may possess better self-regulation skills and greater confidence in managing learning tasks independently.

The study further revealed that perceived learning experience significantly influenced Mathematics achievement in MDL. Students who reported more positive experiences regarding instructional delivery, accessibility, evaluation, and satisfaction tended to demonstrate better academic performance. This finding aligns with the work of Madrazo and Dio (2020), who emphasized that well-designed learning modules enhance students' engagement and conceptual understanding in Mathematics. Similarly, Singh et al. (2016) argued that students who actively engage in the learning process are more likely to achieve higher academic outcomes. The result highlights the importance of improving the quality of instructional materials and learner support mechanisms in modular learning environments.

Age was found to have a significant negative relationship with Mathematics performance, suggesting that younger students performed relatively better than older students within the MDL setting. This finding may indicate that younger learners adapted more effectively to modular learning demands or maintained stronger academic engagement during the pandemic. The result supports the findings of Saka (2021), although it contradicts studies suggesting that older students generally demonstrate greater academic maturity and self-regulation. Such inconsistencies imply that age-related effects on learning may vary depending on instructional context and learning modality.

Grade level also significantly predicted mathematics performance, indicating that students in higher grade levels tend to achieve better academic outcomes in MDL. One possible explanation is that older students may have developed stronger independent learning skills and greater familiarity with mathematical concepts and learning strategies. This finding suggests that learner readiness and academic experience may contribute to successful adaptation in modular learning environments.

Interestingly, technology-related variables such as internet accessibility, internet connectivity, and the availability of technological devices were not found to significantly predict mathematics performance. Although previous studies emphasized the importance of technological resources in distance learning (Maqableh et al., 2021; Moreno-Guerrero et al., 2020), the present findings suggest that access to technology alone may not guarantee improved academic achievement in modular learning contexts where printed modules remain the primary instructional resource. This finding supports Wang (2021), who argued that technology does not automatically improve learning outcomes without effective instructional engagement and learner motivation.

Similarly, household income and parental educational background were not statistically significant predictors of mathematics achievement. While previous literature commonly associates socio-economic status and parental education with academic success (Capinding, 2021; Kunwar, 2020), the present findings may indicate that students' individual learning experiences and prior academic competencies exerted a stronger influence on performance during modular learning than socio-economic variables alone.

Overall, the study demonstrates that Mathematics achievement in Modular Distance Learning is influenced more strongly by prior academic preparedness and quality of learning experiences than by demographic or technological factors. The findings emphasize the need for schools and educators to strengthen instructional support, improve module quality, and provide targeted academic interventions for students with weak foundational skills in Mathematics.

6. Conclusion

According to the study's findings, perceived learning experiences in MDL, previous grades in Math, age, and grade level emerged as significant predictors, with previous math grades having the greatest impact. Gender, parents' educational backgrounds and income, internet accessibility, technology use, and an internet connection, on the other hand, did not affect students' MDL Mathematics performance. Math performance in MDL is predicted as follows: Math Performance in MDL = 47.95 + (0.374 * previous grade in Math) + (0.602 * perceived learning experience) - (0.256 * age) + (0.756 * grade level). The study could help educators improve MDL delivery by providing better learning experiences, leading to higher-quality math performance.

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