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FACTORS ASSOCIATED WITH STUDENT ACHIEVEMENT IN MATHEMATICS, READING, AND WRITING

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Abstract
Academic achievement in mathematics, reading, and writing is shaped by a range of demographic, socioeconomic, and educational influences, yet these factors are often examined separately. Focusing on their combined role, the article investigates how gender, lunch type, parental education, race/ethnicity, and test preparation are associated with student performance across three core subjects. A quantitative cross-sectional design was used with a secondary dataset of 1,000 student records. Descriptive statistics, independent sample t-tests, one-way ANOVA, and Pearson correlation were applied to identify patterns and significant differences in achievement. The findings show that reading had the highest mean score, followed by writing and mathematics. Male students performed better in mathematics, while female students scored higher in reading and writing. Students receiving standard lunch and those who completed test preparation achieved consistently better results across all subjects. Academic performance also increased with parental education, with the highest average scores observed among students whose parents held bachelor's or master's degrees. In addition, strong positive correlations were found among mathematics, reading, and writing, especially between reading and writing. These results suggest that student achievement is not determined by ability alone but reflects the combined influence of family background, socioeconomic conditions, and academic support. The article highlights the need for equitable educational strategies that reduce disadvantage, strengthen family engagement, and expand access to academic preparation in order to improve learning outcomes across core subject areas

Keywords: *Academic Achievement, Socioeconomic Status, Parental Education, Gender Differences, Student Performance, Test Preparation.*

1. Introduction

Academic achievement is commonly accepted as one of the most important parameters of educational achievement and one of the main results of the educational process. It is not only a measure of the cognitive abilities of students but also the impact of the different environmental, social and educational factors. The need to comprehend the determinants of student performance, especially in disciplinary subjects like mathematics, reading, and writing, has been on the increase over the last few years. These topics are the basis of the educational growth and are very important in determining the future academic and professional prospects. There is a body of evidence indicating that student achievement is not a result of one factor but a combination of several factors that are interrelated. Ali et al. (2023) stress that the combination of genders, parenting styles, and socioeconomic conditions influences the academic performance. In a similar manner, Kocak et al. (2021) also underline that academic achievement is a multidimensional notion that is influenced by demographic, psychological, and contextual determinants. This complexity shows that it is necessary to weigh up several factors simultaneously in order to have a holistic view of student performance.

One of the factors that have always been identified to be a determinant of academic performance is socioeconomic status. Harris (2023) notes that students whose socioeconomic status tends to be more privileged have higher chances of academically performing better due to the access to better educational opportunities and learning circumstances. That this observation is supported by Chmielewski (2019), who documents the fact that differences in socioeconomic achievements have been increasing over time around the world indicates that disparities in educational outcomes remain a problem. In addition, Yousif et al. (2023) have found out that socioeconomic factors substantially impact academic performance, particularly in terms of access to learning opportunities and academic support. These findings highlight the need to address socioeconomic inequalities in a bid to improve the overall performance in education. The role of parental involvement and educational background as well is an important factor in determining student achievement. According to Sengonul (2022), the active parental involvement is positively linked to improved academic performance, especially in the presence of a positive socioeconomic background. In addition, the student outcomes are highly influenced by the parental expectations and the educational level. Zhang et al. (2023) show that parental educational expectations are influenced by socioeconomic status and they consequently influence academic motivation and performance of students. The results indicate that family-related aspects are key in explaining differences in student performance.

There is also a well documented gender difference in academic achievement in research into education. Research shows that there usually exists a variation in performance pattern between subjects and that differences are found in both cognitive and behavioral aspects. However, Ali et al. (2023) emphasize the role of gender in academic outcomes that can be positive or negative depending on the subject and other contextual characteristics. These differences are significant in understanding the learning needs of learners and how to develop specific instructional strategies that can be used to meet the needs of different learners. Besides demographic and socioeconomic, psychological and academic factors are also known to affect the performance of students. As an example, Kaushal et al. (2022) single out mathematics anxiety as a major determinant of mathematics achievements, proving that emotional and cognitive elements may have an impact on learning. These results underscore that external conditions are not the only determinants of academic performance but in-house psychological processes too.

Although academic achievement has been well studied, there is need to conduct studies that incorporate various factors in one analytical framework, especially with the use of easy to access and representative datasets. The current research seeks to analyze the variables that relate to student performance in mathematics, reading, and writing. In particular, it aims to examine gender differences in academic achievement and explore the impact of socioeconomic status, as measured by the type of lunch, on student achievement. The research also seeks to determine the influence of parental education to the growth of academic performance and to determine the effects of test preparation on the performance of the student. Moreover, it analyzes the correlation between reading and writing scores to get an idea of the interdependence of academic outcomes related to literacy. All in all, the current study can be viewed as part of the existing body of literature as it provides empirical information on the determinants of student achievement. The results are likely to guide the educators and policymakers to develop strategies that facilitate the realization of equitable and effective learning settings, which will eventually improve student performance in the major academic spheres.

2. Methodology

2.1 Research Design

This research takes a quantitative research design to investigate the factors related to student achievement in mathematics, reading and writing. The analytical method used was a cross-sectional one to determine patterns and variations in academic performance in terms of demographic, socioeconomic, and educational variables. The design allows a systematic statistical comparison and helps to interpret the results of student performance based on evidence.

2.2 Population and Sample

The research will be conducted on the secondary data of 1,000 student records (Chauhan, 2022). The data will entail student background traits and math, reading, and writing academic achievement scores. The sample is diverse enough in terms of variability and representation to perform meaningful statistical analysis, and to test associations between student characteristics and academic achievement.

2.3 Variables of the Study

The study has mathematics score, reading score and writing score that are dependent variables and which are used to

measure the performance of the students in terms of academic performance. The independent variables will include gender, race/ethnicity, level of parental education, lunch type, test preparation course. These variables are significant demographic, socioeconomic and educational variables, which are likely to be associated with student performance variability.

2.4 Data Analysis Techniques

The dataset was summarized with the help of descriptive statistics: the mean scores, standard deviations, and frequency distributions. The relationships between mathematics, reading and writing scores were analyzed using correlation analysis. Independent sample t-tests were used to determine the variation in academic performance in binary variables like gender, lunch type and test preparation course. The analysis of variance (ANOVA) was conducted to assess the differences among variables with more than two categories, such as race/ethnicity and parental level of education. These methods helped to find statistically significant differences and correlations in student achievement.

2.5 Ethical Considerations

A publicly accessible secondary dataset is used with no personally identifiable information used in the study. Thus there was no need of ethical approval. Information was only utilized in an academic context and all results were reported in an aggregated and responsible way.

3. Results and Analysis

3.1 Descriptive Statistics

Table 1 shows the descriptive statistics of the three variables of academic achievement. The results show that reading recorded the highest mean score (M = 69.00, SD = 14.74), followed by writing (M = 67.74, SD = 15.60) and mathematics (M = 66.40, SD = 15.40). This trend shows that pupils did comparatively well in areas involving language than in mathematics. The score ranges also imply that there are significant differences in performance among the three subjects, indicating that the sample is heterogeneous.

Table 1. Descriptive statistics of academic achievement variables

Variable	Mean	SD	Minimum	Maximum
Mathematics score	66.40	15.40	13	100
Reading score	69.00	14.74	27	100
Writing score	67.74	15.60	23	100

Figure 1 shows the mean score of the subjects individually and verifies that reading was the most successful area of achievement and mathematics the least. This descriptive trend gives a preliminary hint that there is different student achievement in different subject domains and thus it is reasonable to analyze mathematics, reading, and writing results separately.

Moreover, the total performance distribution in terms of average scores indicated that 28.7% of the students was below 60, 26.6% between 60 and 69, 23.6% between 70 and 79, and 21.1 between 80 and above. Such findings indicate that despite having a significant percentage of students with moderate-high scores, there is still a significant underperforming group that is still evident in the dataset.

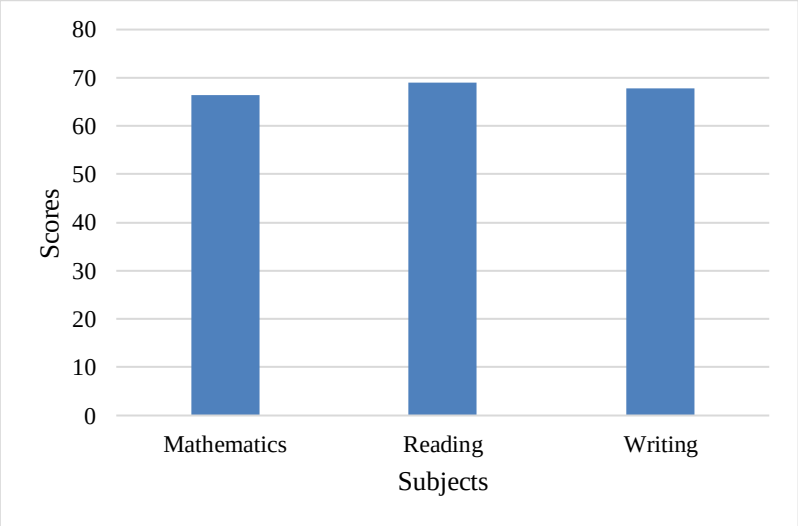

Figure 1. Average performance across mathematics, reading, and writing

3.2 Differences in Achievement by Gender, Lunch Type, and Test Preparation

The average differences in subject scores according to gender are presented in Table 2. Male students performed significantly better in mathematics than female students (69.38 vs. 63.20; $t = 6.47$, $p < 0.001$), whereas female students outperformed male students in reading (71.89 vs. 66.31; $t = -6.09$, $p < 0.001$) and writing (71.71 vs. 64.03; $t = -8.02$, $p < 0.001$). These results show that there is a definite subject-specific gender trend in academic success.

Table 2. Gender differences in mathematics, reading, and writing achievement

Outcome	Group 1	Mean 1	Group 2	Mean 2	t	p
Mathematics score	Male	69.38	Female	63.20	6.47	<0.001
Reading score	Male	66.31	Female	71.89	-6.09	<0.001
Writing score	Male	64.03	Female	71.71	-8.02	<0.001

Figure 2 indicates that male students were only advantaged in mathematics, as compared to female students who showed better performance in reading and writing. The figure is a visual support of the statistical differences found in Table 2.

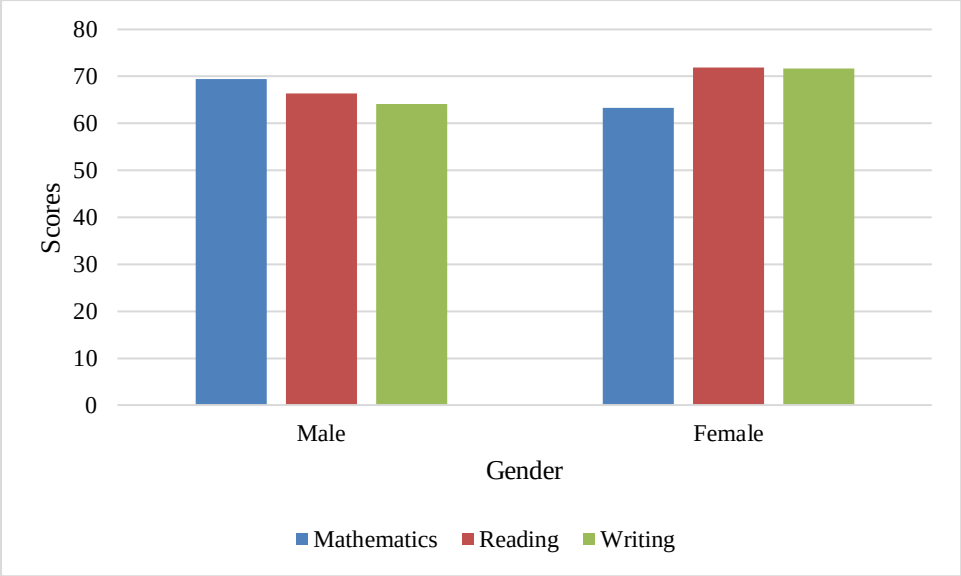

Figure 2. Gender-wise comparison of subject scores

Table 3 shows the differences in the achievement of lunch type and test preparation course. Students receiving standard lunch scored significantly higher than those receiving free/reduced lunch in mathematics (70.61 vs. 58.51; $t = 12.54$, $p < 0.001$), reading (72.10 vs. 63.19; $t = 9.25$, $p < 0.001$), and writing (71.37 vs. 60.93; $t = 10.45$, $p < 0.001$). Similarly, students who completed the test preparation course achieved significantly higher scores in mathematics (69.69 vs. 64.74; $t = 4.85$, $p < 0.001$), reading (74.09 vs. 66.44; $t = 8.15$, $p < 0.001$), and writing (74.67 vs. 64.25; $t = 10.75$, $p < 0.001$). These findings imply that the socioeconomic background and academic preparation have a strong relationship with student achievement.

Table 3. Differences in achievement by lunch type and test preparation

Variable	Category	n	Mathematics Mean	Reading Mean	Writing Mean
Lunch type	Standard	652	70.61	72.10	71.37
Lunch type	Free/reduced	348	58.51	63.19	60.93
Test preparation	Completed	335	69.69	74.09	74.67
Test preparation	None	665	64.74	66.44	64.25

Figure 3 also points out these disparities in terms of average scores. The average achievement of students who had normal lunch and students who had gone through test preparation was always higher as compared to their counterparts. The size of these gaps implies that academic support and socioeconomic factors are significant predictors of performance.

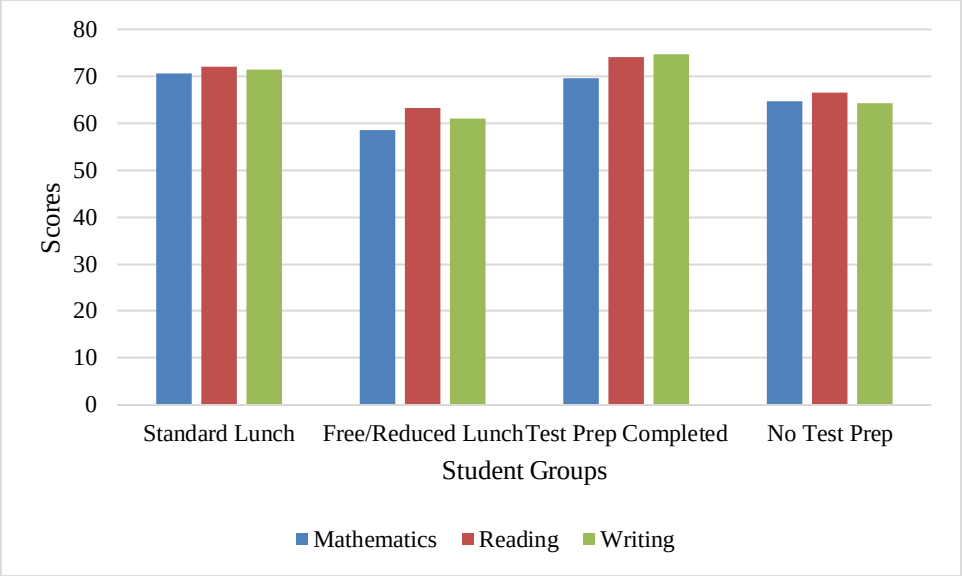

Figure 3. Average score by lunch type and test preparation status

3.3 Differences in Achievement by Parental Education and Race/Ethnicity

Table 4 shows the average scores of achievement in terms of the parental level of education. There is a definite upward trend that is evident in categories. Students with parents who had a master degree had the best average achievement (74.30), then students with bachelor of degree (73.30) and students with associate degrees (70.21). However, students with parents with a mere high school education registered the lowest average (62.55). This trend indicates that the level of education of parents is positively correlated with the academic achievement of students.

Table 4. Mean subject scores by parental level of education

Parental level of education	Mathematics	Reading	Writing	Average score
Some high school	60.70	64.41	62.54	62.55
High school	65.21	67.40	64.85	65.82
Some college	65.30	68.05	66.73	66.69
Associate's degree	69.54	70.99	70.11	70.21
Bachelor's degree	71.49	74.01	74.41	73.30
Master's degree	71.59	75.43	75.89	74.30

The results of the one-way ANOVA presented in Table 5 attest to the fact that parental education was significantly correlated with mathematics, reading, and writing achievement ($p < 0.001$ in all three outcomes). The effect sizes were highest in writing ($\eta^2 = 0.073$), then mathematics ($\eta^2 = 0.057$) and reading ($\eta^2 = 0.052$) which showed a consistent and moderate relationship between subject area.

Table 5. One-way ANOVA for parental level of education

Outcome	F	p	η^2
Mathematics score	12.05	<0.001	0.057
Reading score	10.87	<0.001	0.052
Writing score	15.75	<0.001	0.073

Figure 4 graphically illustrates the trend in an average student achievement by parental education categories. The fact that the jump between some high school and master degree is increasing indicates the conclusion that family educational background is a significant variable that is linked with student achievement.

There were also statistically significant differences in race/ethnicity between the three scores of the subject. The ANOVA results indicated significant variation in mathematics ($F = 18.47$, $p < 0.001$, $\eta^2 = 0.069$), reading ($F = 8.41$, $p < 0.001$, $\eta^2 = 0.033$), and writing ($F = 11.08$, $p < 0.001$, $\eta^2 = 0.043$). The group E had the highest mean mathematics score (74.47) with the group D and E also performing better in reading and writing. These results indicate that achievement differences among subgroups of students exist and must be taken into account when interpreting education.

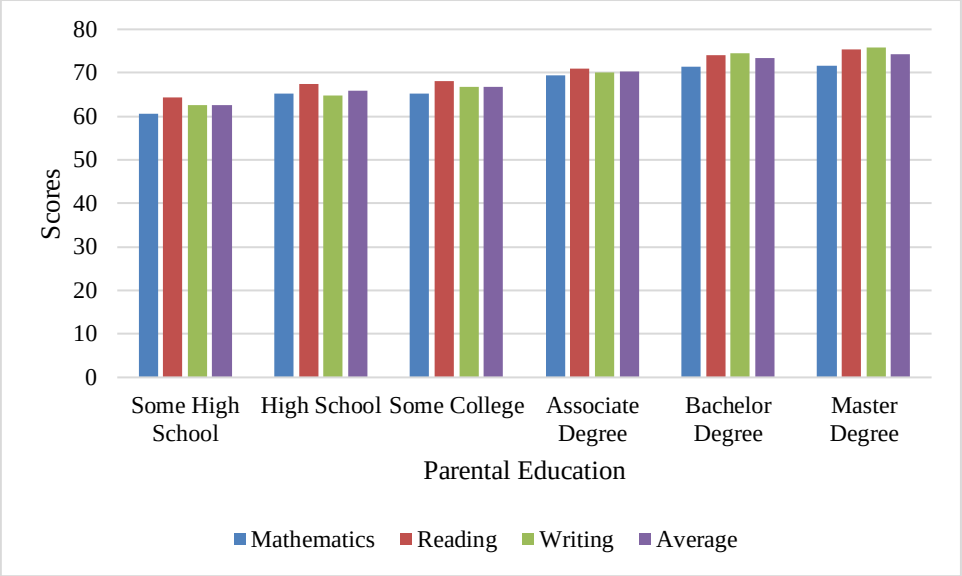

Figure 4. Average score by parental level of education

3.4 Correlation Among Mathematics, Reading, and Writing Achievement

The Pearson correlation coefficients of the three academic subjects are indicated in Table 6. All the correlations were positive and strong thereby showing that the higher the achievement in one domain, the higher would be the achievement in the other domains. The highest correlation was between reading and writing (r = 0.954) and mathematics and reading (r = 0.819) and mathematics and writing (r = 0.806). These results indicate that there is a considerable amount of overlap between skills related to literacy and a general consistency in academic achievement in core subjects.

Table 6. Correlation matrix of mathematics, reading, and writing scores

Variable	Mathematics	Reading	Writing
Mathematics	1.000	0.819	0.806
Reading	0.819	1.000	0.954
Writing	0.806	0.954	1.000

Figure 5 shows the relationship between the score in reading and writing and indicates a distinct positive linear relationship. The clustering of the points around the upward slope justifies the very high correlation observed in Table 6 and shows that students who have high score in reading are likely to score high in writing.

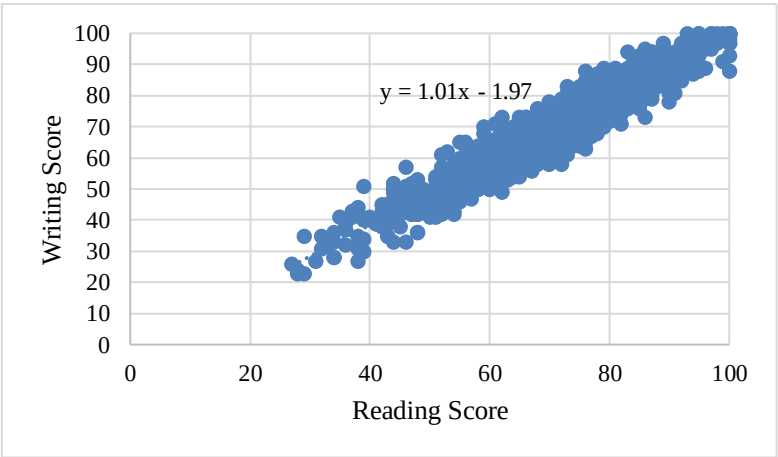

Figure 5. Scatter plot of reading and writing scores

4. Discussion

The current research investigated the variables that relate to student performance in mathematics, reading, and writing with a quantitative analysis of student-level data. The results indicate that there are a set of demographic, socioeconomic, and educational factors that affect academic performance, among which are gender, parental education, the type of lunch, and attendance at test preparation programs. These findings are aligned with the literature and they offer additional support of the complexity of student achievement.

Gender-based differences in academic performance are one of the crucial results of the study. These findings show that

male students were better in mathematics and female students were better in reading and writing. This trend is in line with previous studies, which point towards the existence of gender-specific differences in academic performance. Indicatively, Matz et al. (2017) discovered that the difference in gendered performances usually varies depending on the fields, whereby males tend to excel in quantitative courses and females excel in language-based ones. Also, Buser et al. (2022) indicate that gender disparities in performance can be subject to behavioral and psychological factors, such as competitiveness and confidence, which can influence results in various subject areas. The results of the current research support the idea that gender differences in academic performance are not consistent throughout subjects but differ, and thus, the application of educational approaches in subjects requires subject-specific education.

The other notable finding of this research is that there is a great relationship between socioeconomic factors and academic performance. Students who received standard lunch performed better than the ones who received free or reduced lunch in all the three subjects. This proves the well-established association between socioeconomic status and academic achievement. Munir et al. (2023) stress that higher socioeconomic students are more likely to have access to educational resources, learning conditions, and academic assistance, which lead to better academic results. Likewise, Perales et al. (2023) emphasize that the socioeconomic factors are of paramount importance in influencing the quality of education and student achievement. The findings of the current research are a clear indication that socioeconomic inequality is still a factor affecting academic performance and that policies to mitigate educational inequality are important.

Besides the socioeconomic status, parental education was found to be an effective factor that linked student performance. The findings indicate a positive increase in the academic performance with the increase in the level of parental education. Students with parents who were more educated always scored higher in mathematics, reading and writing. This observation can be confirmed by Bouffard et al. (2023) that discovered that parental attitudes and involvement have a significant effect on academic functioning of students in the long run. On the same note, Derrick et al. (2022) also state that parental involvement and engagement have a positive relationship with student academic performance. Increased parental education has been associated with increased academic support, increased expectations and more effective guidance, which result in better student performance. The present study confirms the importance of family background as a determinant of academic success.

Academic preparation also played a role as observed in the results. Students who attended a test preparation course scored much higher in all the subjects than those who did not attend test preparation. This implies that systematic academic support and preparation are significant in improving the performance of the students. Its results are in line with recent studies which suggest that academic achievement can be greatly enhanced by having access to learning materials and preparation opportunities (Garcia and Weiss, 2020). The findings emphasize the need to offer equal opportunities to preparatory programs especially to the less-privileged students to enhance the overall academic achievement.

In addition, the research found a positive correlation between writing and reading scores with a high degree of correlation meaning that the two areas are interdependent. The analysis through the scatter plot indicated that there was an almost linear relationship and the students who are good readers are most probably good writers as well. This observation goes hand in hand with the realization that literacy skills are related to each other and they reinforce one another. According to Garcia and Weiss (2020), the foundational literacy skills are important to the overall academic achievement, especially in language-based disciplines. The close relationship in this research study highlights the significance of combined teaching methods that can help in the development of reading and writing.

On the whole, the results of the current research confirm the position that academic performance depends on a multifaceted interaction of factors but not on one. Garcia and Weiss (2020) note that the performance of students is influenced by a complex of personal, family, and systemic factors, which all lead to educational outcomes. The current research paper offers empirical data to substantiate this viewpoint by showing the overall impact of demographic factors, socioeconomic status, and educational support on student achievement.

From an educational perspective, the results of this study have important implications. To begin with, gender disparities indicate that special teaching methods should be employed in order to meet subject-specific learning requirements. Second, socioeconomic factors are so powerful that the policies to lessen the inequality in education and to provide disadvantaged students with better access to resources become significant. Third, parental education and involvement implicates that the learning process in schools should be actively incorporated into the families. Lastly, the effectiveness of the positive influence of the test preparation programs denotes that systematic academic assistance can be an effective instrument in enhancing student achievement.

In conclusion, the research paper contributes to the existing literature on the topic by offering a detailed analysis of the variables associated with the performance of students in mathematics, reading as well as writing. These findings indicate that it is important to take into account different factors about the student background and school support to improve academic performance. The research can make valuable contributions to educators, policymakers and researchers with the view of improving educational outcomes since it is consistent with other previous studies and contributes to the knowledge on these relationships.

5. Conclusion

This study has delved into the variables that correlate to the achievement of the student in mathematics, reading and writing on the basis of a quantitative analysis of student data at the student level. The findings suggest that academic performance is influenced by so many demographic, socioeconomic and educational factors. There were significant variations between

males and females, whereby the males were better in mathematics and females in reading and writing. It was also found that lunch type also had a strong correlation with the academic performance with the more affluent students scoring higher in all subjects. Parental education was also found to be a significant factor in determining the student achievement where higher parental education level is positively correlated with student achievement. Besides, the test preparation programs were correlated with higher scores on all three subjects, and the importance of a systemic academic support should not be disregarded. The other interesting discovery of the research was that the performance of reading and writing was significantly positively correlated so that literacy skills are present in a close relationship with each other and can facilitate student success. These findings emphasize the importance of the necessity to take into account different factors of student background and learning support to enhance academic achievements. Educational policies and practices should strive to reduce socioeconomic disparities, promote parental involvement and at equipping academic preparation opportunities equally. In addition, special teaching strategies may need to be undertaken to address subject-specific, gender differences in performance. On the whole, this research adds to the body of knowledge about student achievement through empirical evidence of the contribution of key influencing variables. Future research could be done to study additional variables and longitudinal data to further support the results of academic performance and education growth.

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