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# IMPACT OF DEMOGRAPHIC FACTORS ON ACADEMIC PERFORMANCE IN DIVERSE CLASSROOMS

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***Abstract***
*This study investigates the impact of demographic factors on academic performance in diverse classrooms using a quantitative, data-driven approach. The research is based on a secondary dataset of 1000 students to investigate the effect of gender, race/ethnicity, parental level of education, socioeconomic status (lunch type), and test preparation on academic performance in mathematics, reading and writing. The analysis of data was performed with the help of descriptive statistics, independent samples t-tests, one-way ANOVA, correlation analysis, and multiple linear regression were used. The results show that socioeconomic status and test preparation are the most influential predictors of academic performance, and students who take standard lunch and those who have taken test preparation courses score higher. The level of parental education also demonstrates a significant impact, whereby higher levels are linked to better academic performance. The difference between the genders is statistically significant but not that large. Also, there were significant positive correlations between math, reading, and writing scores, which means that students perform in similar ways in different subjects. The regression model accounts for about 30% of the variance of academic performance, which shows the joint impact of demographic variables. This study highlights the significance of combating demographic disparities in education and suggests that specific interventions are required to aid disadvantaged students.*

***Keywords:*** *Demographic factors, Socioeconomic status, Parental education, Test preparation, Educational inequality*

## 1. Introduction

Academic performance is commonly known as one of the primary measures of student performance and the quality of education systems in general. It does not only capture the personal learning outcomes but also the success of the learning institution in developing knowledge, skills, and competencies that are critical in personal and societal growth. Diversity in classrooms is a growing trend in modern education, which includes students with different demographic factors, namely, they may be of different genders, races or ethnicities, socioeconomic status, and parental education. Although this diversity makes the learning environment more enriching, disparities also emerge, potentially affecting the access of students to educational resources, learning opportunities, and ultimately, their academic performance (Abalos, 2024; Yun & Low, 2024).

An impressive amount of research has shown that demographic factors are a critical factor in determining academic achievement. The socioeconomic status, the educational attainment of parents, and cultural background have always been cited as the most important factors that affect the outcomes of students (Khan et al., 2024; Wang & Chen, 2025). Higher socioeconomic-based students tend to have more access to educational resources, favorable learning environments and academic support systems, which lead to better performance. Likewise parental education has been seen to affect the academic achievement of students in the following ways; parental involvement and parental expectations and providing learning support at home. Moreover, the ongoing differences in academic performance among racial and ethnic groups indicate the structural inequalities inherent in the education system (Wu & Shen, 2026).

In addition to personal and family-related aspects, the institutional circumstances, including school funding, teacher performance, and education policies, also play a part in the discrepancies in student performance (Backes et al., 2024; Jackson & Mackevicius, 2021). They are combined with demographic factors to form complicated patterns of educational inequality. In a more general sense, education is a key factor in human capital building and long-term economic growth, so it is crucial to comprehend and respond to the predictors of academic performance (Hanushek & Woessmann, 2020; Leoni, 2025). It is therefore crucial to explore the effects of demographic diversity on academic performance and ensure equity and inclusivity in education.

In spite of the current initiatives to enhance the educational systems, students in heterogeneous classes still face unequal academic performance. The gaps in achievement are still apparent in various demographics, especially in regards to socioeconomic status, ethnicity, and parental education levels (Jerrim, 2025; Yun & Low, 2024). These differences pose significant questions of equity, equality of opportunity, and effectiveness of current education policies. Although other researchers have addressed the issue of multiple factors affecting academic performance, the relative role of certain demographic factors has not been well understood in most cases (Cao & Mithra, 2024; Kocsis & Molnár, 2025). Thus, empirical studies are necessary to systematically investigate the role of various demographic factors in the differences in academic achievement.

According to the existing literature and theoretical views, the present research hypothesizes that demographic factors have a strong impact on academic performance. The performance gap between male and female students can be an indicator of the differences in learning behavior and academic interest (Lee et al., 2022). Likewise, racial and ethnic differences are likely to continue, because of structural and contextual inequities. The parental education level is expected to be significantly influential in academic performance since it indicates the presence of education support at the family level. The socioeconomic status, or access to resources and opportunities, is also likely to be a critical factor in student achievement. In addition, the involvement in the academic support programs, including the tests preparation, is likely to improve the performance of students, making them better prepared and competent.

The main objective of the research is to examine how demographic variables affect academic achievement in different classrooms. Particularly, the research aims to investigate the impact of factors like gender, race or ethnicity, parental level of education, socioeconomic status and test preparation on student achievement. By so doing, the study will attempt to give a holistic picture of the influence of demographic diversity on academic performance.

The study will add to the body of literature on educational inequality as it will offer empirical data on how the demographic factors influence academic performance. The findings can inform educators, institutions, and policymakers to develop specific interventions to mitigate disparities and ensure equitable learning experiences by identifying the main predictors of the student achievement. Finally, the research will help improve the knowledge regarding the multifaceted connection between demographic diversity and academic performance, which will help to build more inclusive and effective education systems.

## 2. Methods

### 2.1 Research Design

This research design is quantitative since it involves investigation of the influence of demographic variables on academic achievement in heterogeneous classrooms. A cross-sectional design was used, and secondary data were used to examine the associations between student variables and academic performance at one time. The data analysis was performed in Python in the Google Colab environment, which guarantees a systematized, transparent, and reproducible data analysis process.

### 2.2 Data Source

The research is founded on a publicly available secondary dataset of 1000 records of students. The data set contains the demographic data about the students and the performance of the students in mathematics, reading and writing (Aman

Chauhan, 2022). It represents a heterogeneous classroom situation, which encompasses differences in gender, ethnicity, socioeconomic status, and parental education and thus is appropriate to analyze the disparities in academic performance.

**2.3 Dataset Description**

The sample size will be 1000 observations and 8 variables, including both demographic characteristics and academic performance indicators. The demographic variables are gender, race/ethnicity, parental level of education, lunch type as a determinant of socioeconomic status, and enrolment in a test preparation course. The performance of the academic is gauged by three continuous measures: math score, reading score, and writing score. All of these variables combined offer a multifaceted foundation for the analysis of the impact of demographic diversity on the academic performance of students.

**2.4 Variable Classification**

Demographic factors are considered to be independent variables in the present study, such as gender, race/ethnicity, parental level of education, type of lunch, and test preparation course. Dependent variables are academic performance indicators, which include math score, reading score, and writing score. Moreover, a general performance measure, which can be termed the average score, was calculated by averaging the three scores of the subjects. It is a composite variable that gives a holistic view of the performance of students in academic life and is applied in regression analysis to describe the overall performance trends.

**2.5 Data Preprocessing**

Preprocessing of data was done in Python on the Google Colab platform. The pandas library was used to import the data and then the dataset was examined in terms of its structure, names of variables, and types of data. The data was verified against missing data and duplication to maintain completeness and consistency. Categorical variables were analyzed on the basis of uniformity and then coded into numerical formats where the need arose to enable regression analysis. Further, a derived variable which gave the average score was developed to give a composite measure of academic performance. These preprocessing measures made sure that the data was clean, structured, and fit for any statistical analysis.

**2.6 Software and Python Libraries**

All computations were done in Python in Google Colab, which is a cloud-based computational resource that facilitates reproducible research. Data manipulation and preprocessing were performed using the pandas library, and numerical calculations were done with the help of numpy. Matplotlib and seaborn were used to visualize data to show patterns and distributions. Statistical analyses, including t-tests and ANOVA, were performed using the scipy library. The statsmodels and sklearn were used to perform regression analysis, which allowed estimating the relationships between demographic variables and academic performance.

**2.7 Data Analysis Plan**

The analysis started with the descriptive statistics to summarize the data, such as frequency distributions of the categorical variables and values like mean, standard deviation, minimum and maximum of the academic scores. Then, comparative analyses were carried out to discuss the differences in academic performance by demographic groups. Binary variables like gender, lunch type, and test preparation course were analyzed using independent samples t-tests whereas the one-way analysis of variance (ANOVA) was applied to those variables that had more than two categories, like race/ethnicity and parental level of education.

Afterwards, Pearson correlation analysis was conducted to evaluate the correlations between math, reading, and writing scores, which helped to understand the level of interdependence of various academic areas. Lastly, multiple linear regression analysis was used to assess the overall impact of demographic factors on academic performance. The individual subject scores and the composite average score were taken as dependent variables in different models. The categorical independent variables were converted into dummy variables in order to be incorporated into the regression models. This holistic method of analysis was able to identify meaningful predictors and determine their comparative impact on academic outcomes.

**2.8 Ethical Considerations**

The research will use a publicly available and anonymized secondary dataset. There is no personally identifiable data, and no direct contact with human subjects. Consequently, the research does not present any ethical risks and meets the usual research ethics provisions on the use of secondary data.

**3. Results**

**3.1 Data Screening and Preparation**

Before analysis, the dataset was screened for completeness and consistency. The data was composed of 1000 observations and 9 variables such as the calculated average score. The missing values were not identified under any of the variables, which means that the data was fully covered. The identification of only one duplicate record did not greatly influence the overall analysis. These findings affirm that the data were appropriate to undergo further statistical operations.

### 3.2 Demographic Profile of Students

Table 1 gives the demographic characteristics of the sample. The gender distribution is quite balanced in the sample, as 51.7% of the students are male and 48.3% are female. Group C has the highest proportion (32.3%), then Group D (26.2%), Group B (20.5%), and Groups E (13.1%) and A (7.9%) are smaller parts of the sample in terms of race/ethnicity.

The level of education of parents is also significantly different with the largest proportion of students whose parents had some college education (22.2%), then associate degree and high school education (20.3 and 20.2 respectively). The students whose parents have bachelor and master degrees constitute 11.2 and 7.0%, respectively.

Regarding the socioeconomic status as shown by the type of lunch, most students (65.2) have regular lunch, and 34.8% have free or reduced lunch. Further, 66.5 percent of students did not take a test preparation course, as compared to 33.5%. These results affirm that there is demographic diversity in the classroom environment studied (Table 1).

**Table 1. Demographic Profile of Students in Diverse Classrooms**

| Category | Frequency | Variable | Percentage |
|---|---|---|---|
| **male** | 517 | Gender | 51.7 |
| **female** | 483 | Gender | 48.3 |
| **group C** | 323 | Race/Ethnicity | 32.3 |
| **group D** | 262 | Race/Ethnicity | 26.2 |
| **group B** | 205 | Race/Ethnicity | 20.5 |
| **group E** | 131 | Race/Ethnicity | 13.1 |
| **group A** | 79 | Race/Ethnicity | 7.9 |
| **some college** | 222 | Parental Level of Education | 22.2 |
| **associate's degree** | 203 | Parental Level of Education | 20.3 |
| **high school** | 202 | Parental Level of Education | 20.2 |
| **some high school** | 191 | Parental Level of Education | 19.1 |
| **bachelor's degree** | 112 | Parental Level of Education | 11.2 |
| **master's degree** | 70 | Parental Level of Education | 7 |
| **standard** | 652 | Lunch | 65.2 |
| **free/reduced** | 348 | Lunch | 34.8 |
| **none** | 665 | Test Preparation Course | 66.5 |
| **completed** | 335 | Test Preparation Course | 33.5 |

### 3.3 Descriptive Statistics of Academic Performance

Table 2 summarizes descriptive statistics of academic performance variables. The mean math score is 66.40 (SD = 15.40), while the mean reading score is slightly higher at 69.00 (SD = 14.74). The average score in writing is 67.74 (SD = 15.60), which means that performance is quite consistent among subjects.

**Table 2. Descriptive Statistics of Academic Performance Scores**

| Variable | Mean | Std_Deviation | Minimum | Maximum |
|---|---|---|---|---|
| **math_score** | 66.4 | 15.4 | 13 | 100 |
| **reading_score** | 69 | 14.74 | 27 | 100 |
| **writing_score** | 67.74 | 15.6 | 23 | 100 |
| **average_score** | 67.71 | 14.51 | 21.67 | 100 |

The mean of the composite average score, the total academic performance, is equal to 67.71, and the standard deviation is 14.51. The lowest scores are 13 in mathematics, 27 in reading and 23 in writing with the highest score in all subjects being 100. These findings can be interpreted as moderate differences in student performance and imply a higher reading score in general than math and writing scores (Table 2). Figure 1 indicates that the scores of students in the three subjects are distributed approximately normally with the majority of the scores being clustered in the mid-range. Scores in reading and writing are a bit higher and more concentrated than in math, which means that there is a comparatively higher and more consistent performance in the language-based subjects.

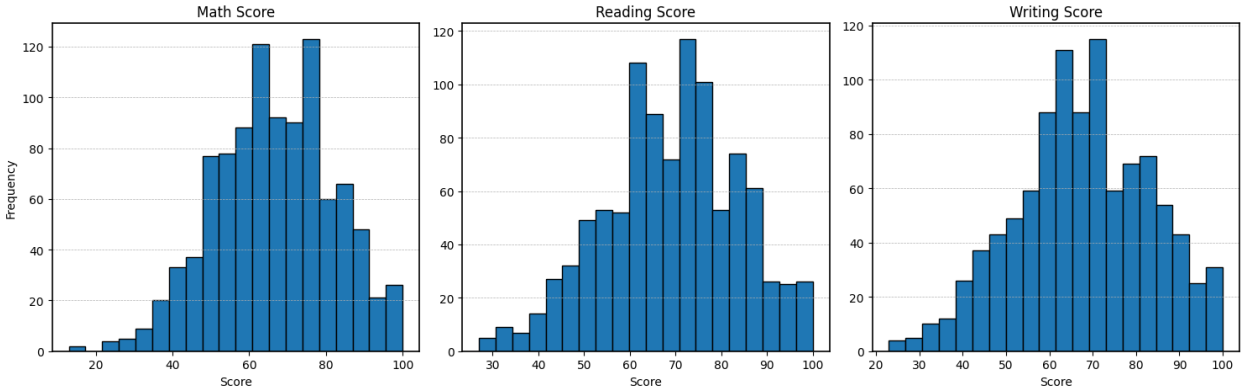


**Figure 1. Distribution of Math, Reading, and Writing Scores**

### 3.4 Differences in Academic Performance Across Demographic Groups

Independent samples t-tests and one-way ANOVA were used in order to test the difference in academic performance based on demographic factors. The findings reveal that there is a statistically significant difference in academic performance between the male and female students ($t = -2.5743$, $p < 0.05$), implying that gender affects student performance.

The socioeconomic status, as indicated by the type of lunch, has a strong and highly significant impact on academic performance ($t = 11.5884$, $p < 0.001$) with students who receive standard lunch performing better than those who receive free or reduced lunch. Likewise, attendance of test preparation classes leads to a strong academic performance ($t = 8.1468$, $p < 0.001$).

The ANOVA results also indicate that there are significant differences between the groups of race/ethnicity ($F = 12.7433$, $p < 0.001$) and parental level of education ($F = 14.0086$, $p < 0.001$). These results show that cultural background and family educational context are significant predictors of academic performance. Figure 2 shows the difference in performance between the gender groups.

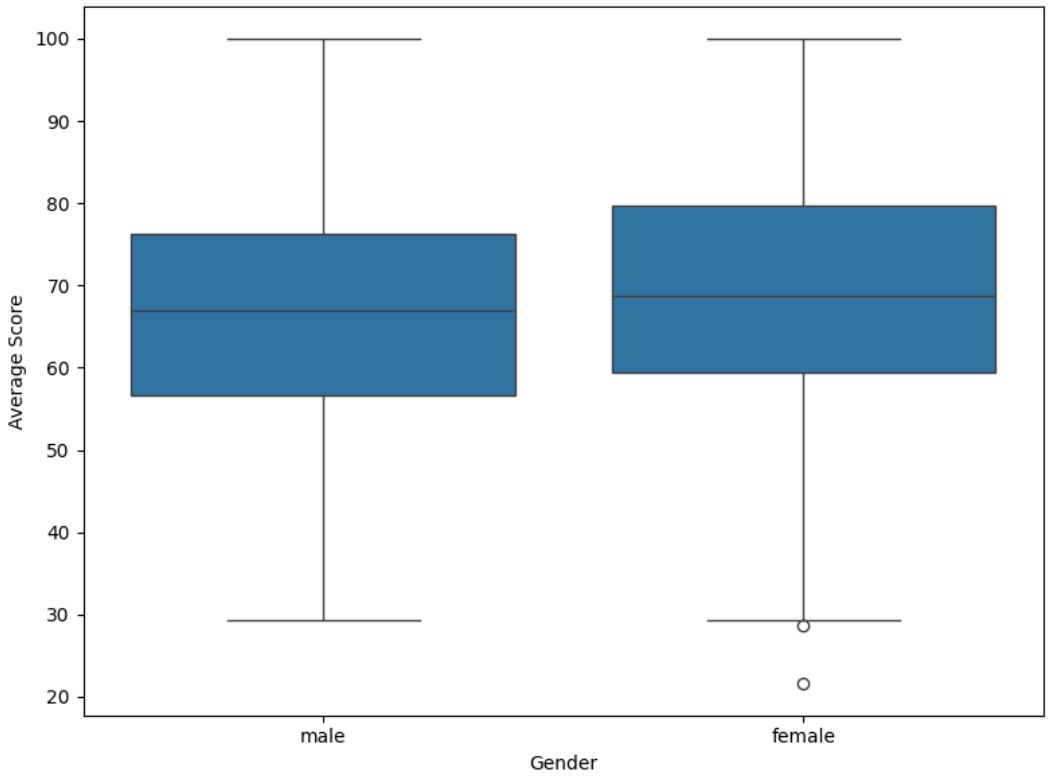


**Figure 2. Comparison of Average Academic Performance Across Gender Groups**

### 3.5 Correlation Among Academic Performance Variables

The Pearson correlation analysis was performed to evaluate the relationships among math, reading, and writing scores. As shown in Figure 3, the results suggest that there are strong positive correlations between all three variables. The correlation of math scores with reading scores (r = 0.819) and writing scores (r = 0.806) is strong, but the correlation between reading and writing scores is the best (r = 0.954). These results indicate that academic performance is very similar across various subject areas and therefore students who excel in one area will tend to excel in other areas.

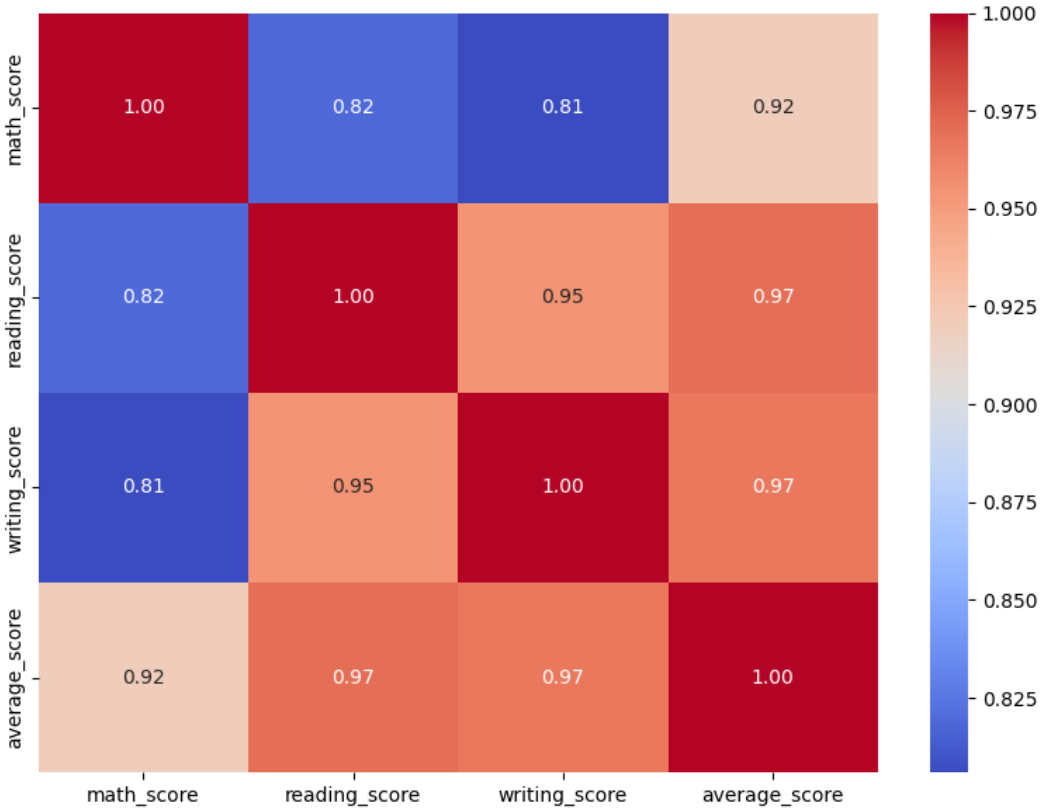


**Figure 3. Correlation Matrix of Academic Performance Variables**

### 3.6 Regression Analysis of Demographic Factors

To study the influence of demographic variables on overall academic performance, in terms of average score, multiple linear regression analysis was conducted. Table 3 shows the results. The model describes about 30 percent of the variation in academic performance ($R^2 = 0.300$), indicating a moderate level of explanatory power. The regression coefficients indicate that the effect of gender is significant with male students scoring lowly on average than female students ($\beta = -2.66$, $p < 0.01$). Socioeconomic status emerges as one of the most influential predictors, as students receiving standard lunch perform significantly better ($\beta = 10.19$, $p < 0.001$).

Test preparation is also a strong predictor, with students who did not complete the course scoring significantly lower ($\beta = -7.37$, $p < 0.001$). Among race/ethnicity groups, students in Group D ($\beta = 5.38$, $p < 0.01$) and Group E ($\beta = 8.22$, $p < 0.001$) show significantly higher performance compared to the reference category, while other groups do not show statistically significant differences.

Parental education exhibits mixed effects. Students with parents holding a master's degree perform significantly better ($\beta = 4.57$, $p < 0.01$), whereas students with lower levels of parental education, particularly some high school ($\beta = -7.91$, $p < 0.001$) and high school ($\beta = -4.63$, $p < 0.001$), perform significantly worse. These findings highlight the critical role of family background in shaping academic outcomes (Table 3).

**Table 3. Multiple Linear Regression Results for Predicting Academic Performance (Average Score)**

| | Coefficient | Std_Error | t_value | p_value |
|---|---|---|---|---|
| **const** | 67.7977 | 1.8336 | 36.9761 | 0 |
| **gender_male** | -2.66 | 0.7829 | -3.3974 | 0.0007 |
| **race_ethnicity_group B** | -0.7514 | 1.6237 | -0.4628 | 0.6436 |
| **race_ethnicity_group C** | -0.6515 | 1.5419 | -0.4225 | 0.6727 |
| **race_ethnicity_group D** | 5.3791 | 1.5747 | 3.4159 | 0.0007 |
| **race_ethnicity_group E** | 8.2173 | 1.7498 | 4.6961 | 0 |

| | | | | |
|---|---|---|---|---|
| **parental_level_of_education_bachelor's degree** | 2.2262 | 1.4458 | 1.5397 | 0.1239 |
| **parental_level_of_education_high school** | -4.6325 | 1.2198 | -3.7977 | 0.0002 |
| **parental_level_of_education_master's degree** | 4.5733 | 1.7066 | 2.6798 | 0.0075 |
| **parental_level_of_education_some college** | -3.1634 | 1.1895 | -2.6594 | 0.008 |
| **parental_level_of_education_some high school** | -7.9106 | 1.2388 | -6.3855 | 0 |
| **lunch_standard** | 10.194 | 0.8174 | 12.472 | 0 |
| **test_preparation_course_none** | -7.3666 | 0.8226 | -8.955 | 0 |

### 3.7 Summary of Findings

In general, the findings reveal that academic achievement in heterogeneous classrooms is greatly determined by various demographic aspects. The most significant predictors would be socioeconomic status and test preparation, then the parental education and race/ethnicity. The effect of gender is also statistically significant but relatively small. In addition, the high correlations between academic subjects indicate that there is coherence in the performance of students. These results corroborate the main assumption in the study that demographic diversity is an important determinant of academic outcomes.

## 4. Discussion

The results of this research indicate that demographic variables play a significant role in academic achievement in heterogeneous classrooms. Among the variables under scrutiny, socioeconomic status, test preparation, and parental education proved to be the most powerful predictors of student achievement. The students who received standard lunch, which is a proxy of higher socioeconomic status, achieved higher performance in comparison to those who received free or reduced lunch, which demonstrates the importance of economic resources in terms of determining educational results. This is consistent with the general views of the economics of education, which stresses the significance of resource and opportunity access in academic achievement (Peña & Galigao, 2024).

There was also a significant positive performance effect of test preparation, which suggests that academic support that is organized can improve learning outcomes. Also, parental education was a strong determinant of student performance, whereby, the higher the parental education, the higher the student performance. This implies that family background is a key factor in promoting academic success, which might be by way of greater support, expectations and access to learning resources (Nasir & Ul-Durar, 2025).

There were also gender differences, but the effect size was relatively small in comparison to other predictors. Male students also showed a small but less than female students, which can be attributed to the differences in motivation, expectations, or learning behavior, as previous literature on gender and academic performance (Lee et al., 2022). Altogether, these results prove that demographic diversity is one of the determinants of academic achievement.

Findings of this research align with the literature on educational inequality and student performance. Previous studies have emphasized the enduring impact of socioeconomic status on academic performance, with students of better socioeconomic backgrounds being more likely to perform better in education (Naim, 2025; Peña & Galigao, 2024). The robust impact of lunch type that is evident in this research supports this argument and proves that economic inequalities still determine student achievement.

On the same note, the strong influence of parental education goes hand in hand with the previous evidence that parental background is crucial to academic achievement. Research has revealed that parental support and educational level are factors that influence the learning environment and motivation of students (Nasir & Ul-Durar, 2025). The differences in demographic groups also indicate the wider trend of inequality observed in the research on inclusive education, which underlines the necessity to consider intersectional issues that impact student achievement (Lansey et al., 2026).

Previous studies show the relevance of structured learning interventions and mentoring to support the role of test preparation in enhancing academic performance. Mentoring programs and other effective academic support systems have been found to improve student engagement and performance (Wong, 2025). Moreover, the incorporation of data-driven techniques into education research, such as computational and analytical techniques, has become a growing focus on enhancing educational understanding and achievements (Zhang et al., 2025).

The beneficial outcome of test preparation underscores the relevance of structured academic support programs. Preparatory courses and mentoring programs should be invested in schools and institutions to improve student performance, especially those who are at risk of poor performance. Third, parental education has an impact, which highlights the importance of involvement of parents in the learning process and policies that would facilitate parental involvement in learning.

On a more general level, the findings highlight the significance of inclusive education policies that are responsive to the needs of students with varied needs. Learning institutions need to embrace policies that enhance fairness and enable every student to have equal chances of achieving success irrespective of their demographic factors (Naim, 2025).

The data-driven approach to the field of educational research is consistent with the new tendencies of using complex analytical tools and artificial intelligence to enhance educational outcomes (Ziemba et al., 2024). This study offers a

framework that can be utilized in the future to conduct evidence-based research on education through the use of an open and reproducible analytical approach that can be applied to other datasets and research settings.

The study has a cross-sectional design, which restricts the possibility of making causal inferences. Although the analysis reveals the existence of significant relationships between demographic factors and academic performance, it does not prove causality. Moreover, longitudinal data is not available, which does not allow investigating the dynamics of academic performance over time. These drawbacks are typical of the issues that are observed in quantitative research and demonstrate the necessity of more detailed study designs (Field, 2024; Hirose & Creswell, 2023).

In future studies, it is hoped that these limitations can be overcome by including a wider array of variables, such as behavioral, psychological, and classroom-level variables. It would be more effective to broaden the analysis to incorporate school-level and institutional variables that would provide a more detailed image of the factors that affect academic performance. Lastly, the application of more sophisticated methods of analysis, such as artificial intelligence and machine learning models, should be examined in future studies to improve predictive accuracy and aid in data-driven decision-making in education.

## 5. Conclusion

This study examined the impact of demographic factors on academic performance in diverse classrooms using a quantitative, Python-based analytical approach. The results indicate that demographic factors, especially socioeconomic status, parental education, and test preparation, are important factors that influence student academic performance. Higher socioeconomic backgrounds, as reflected in standard lunch status, were found to be associated with better performance of students, pointing out the effect of accessibility to resources and learning opportunities. In the same way, enrollment in test preparation programs was linked to higher academic achievement, and the significance of systematic academic support should be underlined. Parental education was also found to be a major determinant and parental education was found to have a positive effect on student achievement. Even though gender differences were identified, they exerted a relatively lesser impact compared to other demographic factors. Also, the high correlations between math, reading, and writing scores suggest consistency in student performance in various subject areas. On the whole, the research highlights the significance of tackling demographic disparities in education in order to facilitate fair learning results. The results indicate that special intervention strategies such as socioeconomic assistance and academic preparation interventions play a critical role in minimizing achievement disparities. Moreover, Python and Google Colab allow demonstrating the importance of data-driven and reproducible methods in educational research. This research will help understand the role of demographic diversity in academic performance better and will form a basis of future research and policy formulation to have inclusive education systems.

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