Investigating the Crucial Role of Parental Education Level, Race, and Gender in Shaping Students' Academic Performance

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Abstract

Assessing performance is the traditional method of progressing students through the educational ladder. It provides educators insights into students' abilities and their advancement towards educational objectives. Contemporary society rewards academic excellence as a predictor of a child's future professional success. Education stakeholders are thus interested in knowing and adequately addressing factors that affect students' academic performance to enhance students' academic success. It is well established that a booming economy relies on the literate and qualified mathematicians its educational institutions produce. This study investigated the impact of parental education levels, gender, and race/ethnicity on the academic performance of high school students in mathematics, reading, and writing. The study was based on a 1000-sample dataset collected from students aged 15-17 from three high schools in the United States. The additional features in the dataset used for this study included lunch status and test preparation to course completion. The aggregate marks attained by students in the different subjects were used as academic performance scores. Exploratory analysis of the dataset revealed its patterns. Additionally, a t-test and analysis of variance were conducted to determine the influence of the three independent variables on the target (i.e., academic scores). Findings revealed that parental education levels, gender, and race/ethnicity statistically predict students' academic performance. Based on the findings, education stakeholders can devise sustainably effective strategies to identify and support at-risk students and address the identified factors in the long term, empowering them to make informed decisions for the benefit of students.

Keywords: parental effects on students, demographic effects on students' performance, high school students, academic performance prediction

1. Introduction

Literacy (i.e., numeracy, reading, and writing) is a fundamental skill for shaping future employees' analytical and problem-solving skills and a crucial element in national development. Research has indicated that insufficient reading skills among learners may adversely impact their ability to learn mathematics. Moreover, it has been suggested that the quality of schooling significantly influences mathematics and reading achievement (Bohlmann & Pretorius, 2008; USAID/Ghana Learning, 2018). Mathematics stands out from all angles primarily because those who pursue mathematics at a higher level and potentially pursue it as a career are expected to be proficient in literacy, possess strong moral character, maintain emotional stability, and have a passion for employing quantitative methods in economic and everyday reasoning. Therefore, literacy is crucial in national development (Narayan, 2015). Education stakeholders, including parents, the government, private sector enterprises, and local and international investors, need literacy experts to support their activities and the country's economic growth.

Mathematics is fundamental for calculating various indicators of national income, such as net national product (NNP), gross domestic product (GDP), gross national product (GNP), the rate of literacy, life expectancy, and other related measures (Zehri & Abdelbaki, 2013). On the other hand, literacy is essential for understanding and interpreting economic data, including reports on inflation, unemployment rates, consumer spending, and

trade balances (Smith, 2020). Without literacy, individuals may struggle to comprehend the significance of these indicators and their implications for the overall health of an economy. Given the importance of these subjects in students' academic success, it has been emphasized that learning mathematics and student achievement are national problems in most countries (Downey, 2023).

According to the 2022 Program for International Student Assessment (PISA), a worldwide study organized by the Organization for Economic Co-operation and Development (OECD), American adolescent students lag behind those in other developed countries in mathematical literacy (Downey, 2023; Mullis et al., 2012). It was reported that 66% achieved basic mathematics proficiency, ranking 28th among the 37 OECD countries. Owing to American students' successive trailing in many developed countries (Downey, 2023), such as ranking 38th out of the 71 countries in 2015 PISA and dropping mathematics scores in the National Test Results Program in 2022, several strategies have been employed to address this issue, such as investing heavily in elementary and secondary education, curriculum development and in-service training offered by higher education institutions and education departments.

The poor performance of students from developed and developing countries has been a major concern for several decades. Education stakeholders, including researchers, policymakers, and higher education administrators, are also concerned about student retention. Nevertheless, concerns about the factors influencing students' academic achievement have been established. Researchers have raised a primary concern that a collection of socioeconomic or demographic and school factors exert a significant effect on students' academic performance (e.g., Koza et al., 2017; Mutodi & Ngirande, 2014; Odoh et al., 2017; Rahman et al., 2023; Reza & Reza, 2011; Younes et al., 2023). These determinants include parental education levels and occupation, socioeconomic background, ethnicity, gender, parental involvement, teacher and peer influence, quality of the school, young adult self-efficacy, and the neighborhood in which the children live. Researchers have explored the relationships among these factors, identifying some with a more significant direct impact.

According to (Chiu et al., 2016; Odoh et al., 2017; Reza & Reza, 2011), parental education levels positively influence academic achievement. This implies that students whose parents are educated are more likely to succeed in educational achievement. Other research has shown that race/ethnicity (Cokley & Chapman, 2008; Rucinski, 2022; Zewolde, 2022) and gender (Rahman et al., 2023; Sharma & Jha, 2014) impact academic performance. In this context, the significance of demographic factors, such as parental education, is unquestionable (Mji & Makgato, 2006).

As previously noted, a considerable number of studies have explored the connection between socioeconomic or demographic information and academic achievement, with most focusing on colleges, universities, or post-secondary students (e.g., Chiu et al., 2016; Odoh et al., 2017; Rahman et al., 2023). However, there appears to be little significant focus on operationalizing these concepts in young adults by combining different subjects in a single study.

Concerning this frame of reference, the present study aimed to expand the existing knowledge by investigating the potential routes from parental education to students' academic achievement. Specifically, we aimed to explore the demographic determinants that affect the academic performance of high school students in the USA in three subject areas. In this light, this paper conducts bivariate analysis and analysis of variance (ANOVA) tests to identify the significant indicators influencing academic performance. The associations between high school students' test scores (i.e., reading, writing, and mathematics) and demographic factors, such as parental education level, gender, and race/ethnicity, were examined through t-tests and ANOVA. This article adds to the prevailing body of literature by providing methodologically sound empirical evidence and insights into the complex determinants affecting high school students' academic achievement, with implications for further research and practical educational interventions.

This research examined the impact of demographic determinants, namely, parental educational level, race/ethnicity, and gender, on high school students' mathematics, reading, and writing academic performance by examining the following three hypotheses:

1. Parental educational background significantly impacts high school grades/scores.
2. Gender is a statistically significant predictor of students' academic performance.
3. Family and racial/ethnic backgrounds significantly affect students' academic performance.

The results of the study confirmed the validity of all the above three hypotheses. Examining the associations between the test scores and demographic variables using t-tests and ANOVA ensured the robustness and reliability of the findings.

The remaining sections of this paper are structured as follows: Section 2 reviews related works. After this, the materials and methods are discussed, followed by the results and discussion. Finally, conclusions are presented, including possible future extensions and limitations of the work.

2. Literature Review: Theoretical Framework

Education entails structured teachings to acquire information and knowledge to foster skill development and comprehensive professional growth. It unlocks and actualizes individuals' inherent potential and hidden abilities (Anderman et al., 1999). Education cultivates critical thinking skills and sound decision-making abilities in individuals. Knowledge is acquired and disseminated through education, shaping the world's collective understanding. Education provides insight, instills moral values, increases knowledge, and develops skills. It is claimed that highly qualified and academically sound people are needed in every area of endeavor (Musarat et al., 2013). This suggests that academic performance is significant to one's educational success.

Academic performance typically denotes the accomplishment reached within academic domains or, more broadly, educational endeavors. Achievement incorporates both the abilities and actual performance of students. It is a multifaceted concept closely intertwined with the overall growth of individuals, encompassing cognitive, emotional, social, and physical development. According to Steinberg et al. (1992), academic achievement portrays a holistic view of the student, spanning various stages of their life journey, from elementary and secondary school through postsecondary education and into their professional career. Similarly, Alkhutaba (2013) states that academic performance is a broad name for educational attainment and is typically considered the demonstration of skills developed or the knowledge achieved in a specific subject in the school.

In another view, the Cambridge University Reporter (2003) stipulates that academic performance relates to only examination performance. This is usually characterized by learners' performance on quizzes, coursework, tests, and examinations, generally measured at pre-tertiary levels. At the tertiary level, students' academic performance is measured in diverse ways, such as test and exam results, and later combined with several units in a study period to form CGPA or GPA. Nonetheless, according to (e.g., Geiser & Santelices, 2007; Rahman et al., 2023), students' academic performance is influenced by several factors not limited to family and socioeconomic background, admission points, and school environment. In the same way, earlier research (i.e., Swart,1999) affirmed that high school or university entrance exam grades reflect the performance from previous studies, undoubtedly influencing future academic success. These perspectives suggest that family, socioeconomic status, and environment influence students' academic performance. Many studies have illuminated their views on the meaning of academic performance. The present study uses the definition that characterizes academic performance as students' test scores or grades.

2.1 Effects of Parents' Level of Education on Academic Performance

It is well acknowledged that parents' educational backgrounds play a significant role in a learner's academic achievement (Younes et al., 2023). Thus, concepts relating to parental education are increasingly employed to explain discrepancies in academic performance in developing and developed countries (e.g., Nelson, 2009; Odoh et al., 2017; Sánchez et al., 2006; USAID/Ghana Learning, 2018; Younes et al., 2023). Generally, this factor refers to the educational background of parents who serve as sponsors, caregivers, and guardians of students. The educational background encompasses the number of schools attended and the types of certificates obtained, ranging from primary to tertiary levels. Parents uniquely possess the ability to exert a consistent positive influence, which could augment and supplement the educational environment provided by schools. One of the most precise and direct explanations for the connection between parents' level of education and their children's academic success is rooted in the belief that parents acquire valuable knowledge during their schooling, which shapes how they engage with their children in educational activities at home (Davis-Kean, 2005).

Alexander et al. (1994) suggested that parents' education level can contribute to their efficacy as educators at home. This is attributed to their increased likelihood of understanding their children's academic curriculum, enabling them to assist with homework and offer suitable cognitive stimulation outside school hours. According to Haveman and Wolfe (1995), parents with lower levels of education might have difficulty providing practical support for their children's academic success and career aspirations. Swart (1999) concurred with this view and pointed out that parents' educational level is paramount to students' academic achievements. Considine and Zappala (2002) confirmed that parents' educational levels impact students' academic performance in Australia. In a study on American students, Stinebrickner and Stinebrickner (2003) found that additional determinants related

to family status were significant. Their research revealed that the influence of family income diminished when at least one of the students' parents held a college degree (Stinebrickner & Stinebrickner, 2003).

The importance of parental education levels and their influence on college students' academic performance was also supported by Ortiz and Dehon (2008). Nevertheless, they revealed that mothers' educational levels played a more crucial role in predicting student academic achievement than fathers. Chiu and Khoo (2005) found a significant correlation between the test scores of 15-year-old students and the average years of schooling their mothers completed. Acharya and Joshi (2009) emphasized this concept in a similar domain in Iran. They stipulated that parents with higher levels of education instill the importance of education in their children, thereby influencing the child's aspirations and academic accomplishments. However, they found no relationship between fathers' educational level and students' academic achievements. In the same context, Reza and Reza's (2011) research on social and cultural factors affecting undergraduate students' literacy performance revealed a relationship between parents' education and children's educational attainment. However, fathers' education was not significant or was not a strong predictor of students' academic achievement, while mothers' education predicted 23% of the variance in students' attainment (GPA). These findings can point to one reason in Iran's context: fathers work outside the home, while mothers are at home with their children and providing care and education/home support (Reza & Reza, 2011). Furthermore, these findings contrast with those of Nelson (2009), who demonstrated that fathers', not mothers', years of schooling affected their children's academic performance. Chiu et al. (2016) studied the effect of family income and parental education level on New York college students' academic achievement. Chiu et al. found that fathers' education level significantly influenced their children's academic performance.

Other studies that combined and analysed both parents' education levels, such as Baliyan et al.'s (2012) on the effect of socioeconomic factors on secondary school students' academic performance in Botswana, found that parents' income level and educational background notably impact students' mathematics performance. Another study by Sharma and Jha (2014) on the relationship between academic performance, parents' educational level and learners' gender revealed that parental education significantly impacts learners' academic performance. Conversely, Bicer et al. (2013) explored the effects of parents' income and educational level on children's mathematics achievement as mediated through parental communication and expectations. They found a strong indirect relationship between these variables through parental communication and expectations.

A study by Zehri and Abdelbaki (2013) confirmed that parents' educational level impacts students' academic performance. This is because parents are well equipped to serve as additional educators to their children, offering guidance and advice on effective learning strategies and providing the essential resources required for academic success (Odoh et al., 2017). An investigation by Odoh et al. (2017) on the impact of parents' educational levels and occupation on Nigerian tertiary students' academic performance revealed that parental occupation and educational levels have a strong positive relationship with students' academic performance. Odoh et al. suggested that the government should consider extending educational support to less privileged parents by providing them with adult literacy to reposition them to support their wards' academic achievement.

2.2 Effects of Gender on Academic Performance

Gender is another determinant anticipated to influence students' academic performance significantly. Several studies have indicated that boys and girls achieve differently in academic performance (e.g., O'Reilly & McNamara, 2007; Renato, 2016; Tsaousis & Alghamdi, 2022). Clearly, a complex set of determinants influences a learner's academic achievement, and gender may play a role in a student's academic success. This hypothesis has attracted interest in the research community (Tsaousis & Alghamdi, 2022).

Nelson found that male learners have lower academic achievement in terms of GPAs than female learners, with a Pearson correlation coefficient of -0.16 and a p-value < 0.05. However, all other variables, such as weekly study hours and feeling successful and capable, were not highly correlated with gender (Nelson, 2009). Renato (2016) revealed that females report better indicators of achievement. Tsaousis and Alghamdi's (2022) study that explores the gender differences across General Academic Ability (GAA) and four cognitive determinants (verbal ability, quantitative ability, scholastic aptitude, and GPA) in Saudi Arabia high school graduates found gender differences in the verbal and GPA domains, where females scored higher than the males in all cases. Other studies also found similar results. For instance, Spinath et al. (2010) found that female students perform better in language verbal tests (German and English subjects) while their male counterparts outperformed in mathematics. This was evidenced in individual visuospatial tests study (Lakin, 2013) and broader international studies (e.g.., Trends in International Mathematics and Science Study or TIMSS), where males outperformed females in STEM

(Science. Technology, Engineering, and Mathematics) related subjects (Mullis et al., 2012; 2016). A meta-analytic study found that female students tend to obtain higher grades in language and mathematics (Voyer & Voyer, 2014). O'Reilly and McNamara (2007) and Rahman et al. (2023) reported that students' gender and other variables, such as age, significantly influence academic performance.

In contrast, Abubakar and Bada (2012) found a low positive correlation ($r = 0.004$) between gender-mathematics and revealed no significant gender difference in mathematics achievement. Similarly, Sharma and Jha (2014) reported no significant differences in gender, with average academic performance scores of 61.61 and 65.65 for males and females, respectively. These findings did not support the hypothesis that males outperform females academically. Similarly, Ajai and Imoko's (2015) study on the possible effects of gender on performance in mathematics revealed that female and male students did not significantly differ in achievement and retention scores and were equally capable of cooperating and competing in mathematics.

2.3 Family Racial and Ethnic

Antony-Newman (2019a) emphasized the importance of parental involvement of immigrant parents in students' academic success and found that immigrant parents encounter distinct hurdles to their engagement, stemming from language barriers and unfamiliarity with the educational system of the host country. Thus, parents from the dominant background in the UK and USA (i.e. native-born group) received more educational benefits for their children than non-native-born, ethnic minorities and immigrant parents (Lareau, 2011).

Zewolde (2022) explored the experiences of 21 black African international undergraduate students (BAIS) studying at ten universities in England. Zewolde found that race and ethnicity compromise perceptions of BAISs' academic capability and assessed work. Cokley and Chapman (2008) discovered that the educational success of African-American college students at a historically black university is influenced by their racial and ethnic identity. Perna and Titus (2005) investigated variations in college enrollment rates among racial and ethnic groups. They highlighted the significance of parental involvement in fostering college enrollment, especially among racial and ethnic groups underrepresented in higher education. Behnke et al. (2004) reported a relationship between parents' education and Latino learners' educational expectations. Similarly, Day and Dotterer (2018) explored parental education involvement's impact on children's academic performance across diverse races/ethnicities. They found that the predictor benefits all adolescents' educational achievement. Rucinski's (2022) study focused on the relationships among learner development, social-emotional and their experiences in racially and ethnically different schools and classrooms. Rucinski's study found promising effects on academic achievement, individual growth, and diversity of groups of students in terms of race and ethnicity.

2.4 Other Social Capitals Impacting Academic Success

Social capital theory (SCT) is built on the hypothesis that social relationships can lead to the accumulation and development of human capital. According to Bourdieu's SCT (1986), "social capital is the aggregate of the actual or potential resources which are linked to the possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" (p. 21). For instance, a stable family setting can support educational success and assist in acquiring valuable and well-regarded skills and qualifications (Machalek & Martin, 2015). Other studies have viewed the prevailing context (i.e. factors affecting learners' academic achievement) concerning social capital (educational and sociological perspectives), which has proven to be a significant predictor of academic achievement. For instance, Robert's (2003) study focused on the impact of social capital (e.g. parent-child relations, teacher/school-pupil relations, and parent-school relations) on students' reading performance. It revealed that parental academic interest and teacher-student relationships were significantly related to students' reading performance. Conversely, Bassani (2006) surveyed students from three countries (i.e., Canada, Japan, and the United States) to examine the relationship between social capital (i.e., family and school social capital) and mathematics scores. Significant associations were found between students' social capital and mathematics scores (Bassani, 2006). However, to test SCT in the dimension that social capital has a positive impact on adolescents' academic attainment, he revealed that while most measures of social capital showed the expected direction, not all of them were significantly linked to mathematics scores.

Research in SCT has attracted wide attention. For example, Eng (2009) conducted a study emphasizing diverse dimensions of social capital (e.g., parents' educational involvement and aspirations, parent-teacher relationships, parent-relative relationships, and family demands). Eng's study revealed a significant correlation between

students' academic performance and familial and educational social networks. In a recent study, Musarat et al. (2013) investigated the effect of family capital (i.e., parental education and socioeconomic status) on Pakistani students' academic performance. They found that, besides parents' educational level, socioeconomic background has positive effects, as students from good financial homes outperformed those who face financial hardship (Musarat et al., 2013).

Fan and Chen (2001) performed a meta-analysis to synthesize quantitative literature on the correlation between students' academic achievement and parental involvement. They found a moderate and practical relationship between the variables, with parental expectations for their children's educational attainment displaying the strongest correlation and home supervision with the least robust connection. Parents' beliefs and expectations regarding their children's intellectual capabilities and academic achievement were correlated in other studies (e.g., Benner, 2016; Porumbu & Necşoi, 2013; Suizzo & Stapleton, 2007). In another meta-analysis on the impact of parental involvement on student performance, Danişman (2017) found that parental involvement is correlated with a modestly positive effect on student academic performance. Conversely, Pinquart and Ebeling (2020) conducted a meta-analysis to assess the association between parents' education expectations and offspring achievement and found that expectations predicted changes in children's attainment. In earlier research, Khajehpour (2011) has affirmed that parental involvement has the potential to predict the academic success of high school students.

Similarly, Rowan-Kenyon et al. (2008) emphasized the importance of support from parents with a college education in shaping students' college attainment. A USAID/Ghana Learning (2018) study on improving children's academic performance in mathematics and a study by Wong et al. (2018) on language competence indicated that parental involvement in children's education is strongly correlated. Antony-Newman (2019b) investigated the different forms of parental involvement that positively influence the educational success of upper secondary vocational education and training (VET) students in Norway. This study, based on students' interviews, revealed five forms of parental involvement: social psychological support, high expectations and aspirations, schoolwork supervision, practical support, and obligation and gratitude toward parents. He also found that these forms are not limited to parents with knowledge of the educational system and higher education levels (Antony-Newman, 2019a). He highlighted the significance of practical support and encouragement from parents with a college education in shaping students' outcomes. In recent studies, Lui et al. (2020) found that marital satisfaction significantly indirectly affects children's academic performance through parental involvement. Aria et al. (2024) revealed that home and family environment factors affect students' achievement.

3. Materials and Methods

This section presents the tools, materials, and methods used to complete the study. Table 1 defines the essential variables and acronyms used in this study.

Table 6. Variables and Their Meanings

Variable/acronym	Meaning
Cohen's d	An effect size is applied to indicate the standardized difference between two means
df	Degrees of freedom
F	F-statistic/ratio of Between groups to Within groups Variances
M	Mean
N	Number of data samples
p	P Value
SE	Standard error?
Std.	Standard deviation
t	t-statistic/ratio of the difference between the mean of the two sample sets and the variation that exists within the sample sets

3.1 The Dataset, Its Source and Features

The dataset (Kaggle, 2018) for the present study originated from an extensive survey conducted in the United States on 1000 high school students with different racial/ethnic backgrounds studying at three high schools. This dataset was selected because it is the best publicly available dataset for the type of research performed in the present study in the sense that it captures the required demographic variables. The demographic information in

the dataset included parents' educational level, gender, race/ethnicity, lunch status, and test preparation to course completion. Among the students surveyed, 518 (51.8%) were females, and 482 were males (48.2%) between the ages of 15 and 17. This suggests that the dataset is reasonably balanced regarding gender. The dataset is accessible online with permission for its general use for educational research (Kaggle, 2018). Therefore, no additional formal permission was needed to conduct the study.

3.2 Measures

3.2.1 Parental Education Levels, Race/Ethnicity, and Gender

The data contains responses from students on their parents'/guardians' highest education. The educational level categories were high school, some high school, some college, associate's degree, bachelor's degree, and master's degree. We recorded biological or guardians/caregivers as parents to provide a concise understanding.

According to the dataset, the students' race/ethnicity backgrounds were classified as Asian, African-American, Hispanic, or other and further divided into five groups (i.e., Groups A, B, C, D, and E). It is essential to note that the dataset did not specify which ethnicity represents which classification. We employed this classification in our analysis because the purpose was to examine the relationship between ethnicity and academic performance, but not which ethnicity attained better scores. Table 2 presents the frequency and percentage results of the surveyed dataset on the three independent variables.

Table 7. Frequency and Percentage Results

Independent Variables	Frequency(N=1000)	Percentage
Gender		
Male	482	48.2%
Female	518	51.8%
Parental education levels		
Master's degree	59	5.9%
Bachelor's degree	118	11.8%
Some high school	179	17.9%
High school graduate	196	19.6%
Associate's degree	222	22.2%
Some college education	226	22.6%
Race/Ethnicity		
Group A	89	8.9%
Group B	190	19.0%
Group C	319	31.9%
Group D	262	26.2%
Group E	140	14.0%

The data shows a variation in parents' education level among high school students. Based on the data, we found that most parents either had an associate's degree or had attended some college. These data also show students across diverse ethnic/racial backgrounds in the three USA high schools. All the students responded to this independent variable, avoiding missing values.

3.2.2 Academic Grades/Scores

This section analyzes the dataset's scores for various subjects. To measure the students' academic performance, the aggregate marks attained by a student in each subject were employed. The students' scores were obtained from standardized mathematics, reading, and writing tests. Table 3 summarizes the descriptive statistics of the overall student performance.

Table 8. Distribution of Students' Academic Scores in the Various Subjects

	Maths Score	Reading Score	Writing Score
No. of students	1000	1000	1000
mean	66	69	68
Std	15.2	14.6	15.2
min	0	17	10
25%	57	59	58
50%	66	70	69
75%	77	79	79
max	100	100	100

Table 3 shows that the mean mathematics, reading, and writing scores are 66, 69, and 68, respectively. This result indicates that students' performance is consistent across these subjects on average, but mathematics scores are slightly lower than writing and reading scores. Upon subject-wise variations from the mean, the mathematics scores were 15.16, the reading scores were 14.60, and the writing scores were 15.20. These figures point to significant diversity in students' performance within each subject, signifying that some students achieve notably higher or lower scores than average. Table 2 also shows that the quartile data suggest that most students score within a relatively narrow range in mathematics, reading, and writing. In contrast, a smaller proportion of students attain higher scores. Moreover, comparing the average and median scores across the three subjects shows that the score distributions are typically slightly skewed or symmetrical. When the average and median closely align, it indicates an evenly spread dataset without significant outliers impacting the average.

3.3 Design

The study employed an exploratory and descriptive approach to analyze the dataset. This design enables efficient collection and analysis of data regarding individuals' personal characteristics and viewpoints and provides generalizable insights from a larger population. To examine the impact of parental education levels and gender on academic performance, we adopted the classification made in the literature (e.g., Odoh et al., 2017; Sharma & Jha, 2014). Thus, parental education levels were dichotomized as follows:

- Low-educated: parents who achieved elementary, secondary, and some college education;
- Highly educated: parents who had attained a tertiary or higher education level.

Figure 1 is the hypothetical figure illustrating the three independent variables and their respective impacts on the target or dependent variable, assessed through statistical hypothesis tests (i.e., ANOVA and t-tests).
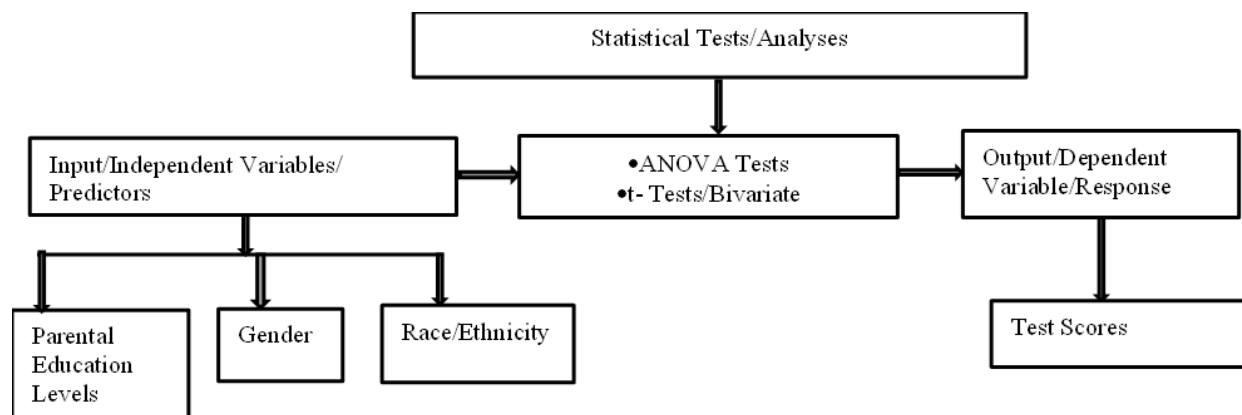

Figure 1. Basic Study's Design

Bivariate (t-test) analysis and one-way analysis of variance were utilized to determine the significant predictors impacting high school student's academic performance. At the 0.05 level of significance, a t-test was carried out to determine the bivariate association or if there was a difference between the mean scores of the groups

according to parental education level (i.e., low and high), gender (i.e., male and female) and ANOVA for race/ethnicity (Groups A, B, C, D, E) (Baliyan et al., 2012; Chiu et al., 2016; Odoh et al., 2017; Sharma & Jha, 2014). Before applying the bivariate analysis and one-way ANOVA, Levene's test was used to assess the homogeneity of variance. The results indicated equal variances, and there was no significant difference in the variances of mathematics scores (F = 0.397, p-value = 0.529), reading (F = 0.017, p-value = 0.897), or writing (F = 0.029, p-value = 0.865), suggesting that the assumption of homogeneity of variance was met. Descriptive and statistical tests were performed using Python Libraries to determine the impact of the independent variables on the dependent variable.

4. Results

4.1 Parents' Educational Background Positively Affects Their Child's High School Grades/Scores

We hypothesized that students with highly educated parents would perform better academically than those with less educated parents. To evaluate the variation between a student's parental education level and academic performance, we computed each subject's mean scores by parental education attained. Table 4 illustrates the mean scores by parents' education levels.

Table 9 Distribution of Mean Scores by Parental Education Level

Parents' Education	Mean Maths Score	Mean Reading Score	Mean Writing Score
High School	62.1	64.7	62.4
Some High School	63.5	66.9	64.9
Some College	67.1	69.5	68.8
Associate's Degree	67.9	70.9	69.9
Bachelor's Degree	69.4	73.0	73.4
Master's Degree	69.7	75.4	75.7

The findings showed that varying parental education levels influenced students' academic performance in mathematics, reading, and writing, where students with highly educated parents performed well across all three subjects, regardless of gender. Although there are fewer students whose parents hold master's degrees, their average scores in each subject exceed those of others. This underscores the critical influence of parental education on student achievement. For further analysis, we conducted an independent samples t-test to compare the differences in means—categorizing parental education levels (i.e., low and high). Table 5 shows the group's descriptive statistics and t-tests.

Table 10. Summary of the T-Test Results for Parental Level of Education and Students' Academic Performance

Parent's level of education		N	M	Std.	SE	df	t	p	Cohen's d
Maths score	Low	601	64.42	15.017	0.613		-4.311	0.000	0.278
	High	399	68.60	15.053	0.754				
Reading score	Low	601	67.16	14.631	0.597	998	-5.421	0.000	0.350
	High	399	72.20	14.037	0.703				
Writing score	Low	601	65.58	15.160	0.618		-6.448	0.000	0.416
	High	399	71.78	14.490	0.725				

The results from Table 5 demonstrate that the difference between the two means is statistically significant across the board, with an absolute t-value higher than 1.91 and a moderate effect size of $0.3 < d < 0.5$. Parental education levels influenced students' mathematics performance; $t(998) = 4.31$, $p < 0.01$. There was a significant effect for reading, $t(998) = 5.42$, $p < 0.01$. The test revealed a significant difference ($t(998) = 6.45$, $p < 0.01$) between parents' education level and writing performance. The students' average scores for each subject were higher for those whose parents were highly educated and lower for those whose parents had a low education

level. Therefore, we concluded that parental education levels significantly predict students' mathematics, reading, and writing academic performance.

4.2 Is There a Significant Difference Between Students' Gender and Their Academic Performance?

We analyzed the data to determine whether gender influences academic performance in mathematics, reading, and writing. Figure 2 compares the subjects' mean scores by sex.
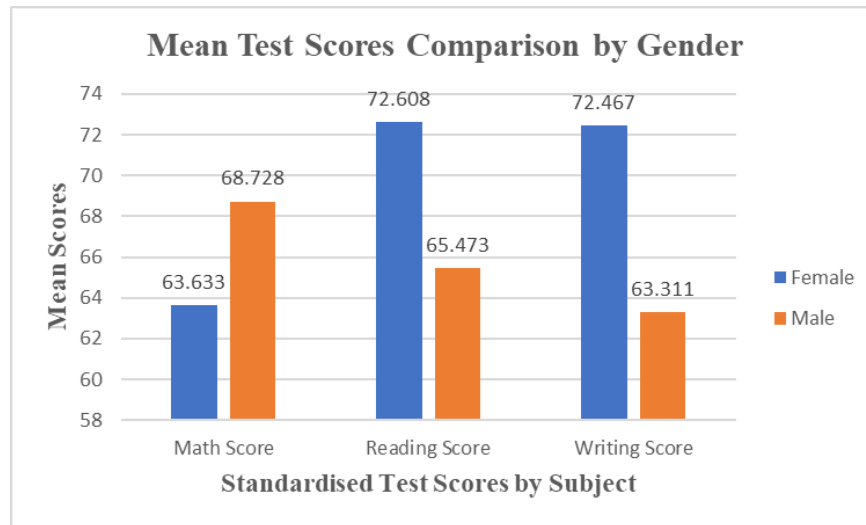

Figure 2. Test Performance by Gender

The findings show that comparing female and male students' mathematics, reading, and writing scores reveals gender-based disparities in these subject areas. However, females show slight differences in reading and writing scores. We performed an independent samples t-test to compare and determine whether the variables had a statistically significant relationship. Tables 6 and 7 display the descriptive statistics and gender differences in the academic performance of the three subjects.

Table 11. Descriptive Statistics of the Subject Scores by Sex

Subject/Gender		N	M	Std.	SE
Maths score	Female	518	63.63	15.491	0.681
	Male	482	68.73	14.356	0.654
Reading score	Female	518	72.61	14.378	0.632
	Male	482	65.47	13.932	0.635
Writing score	Female	518	72.47	14.845	0.652
	Male	482	63.31	14.114	0.643

Table 12. Gender Differences in Academic Test Scores (T-Test For Equality Of Means)

Source/Between Groups	t	df	p	Cohen's d
Mathematics	-5.383	998	9.12019E-08	-0.341
Reading	7.959	998	4.68E-15	0.504
Writing	9.980	998	2.02E-22	0.632

Table 6 shows that males outperform their female counterparts in mathematics, with a mean score of approximately 63.63 for females and 68.73 for males. However, on average, in reading and writing, females

performed better than males, with average means of 72.61 and 72.47, respectively. This suggests that female students are better at literacy (i.e., reading and writing) than numeracy, while males tend to have higher mathematics scores than literacy. This result (Table 7) clearly suggests that the test is statistically significant across all three subjects by gender since $p < 0.01$. Thus, there was a significant difference between the mean scores by gender, and it was concluded that gender was significantly related to students' mathematics, reading, and writing academic scores.

4.3 High School Students' Family Race/Ethnicity Positively Impacts Their Academic Scores

Another problem was whether students' race/ethnicity influences their academic performance. One-way ANOVA was conducted to evaluate the difference between a student's race/ethnicity and academic performance in the three subjects. As mentioned, students were grouped into five groups according to race/ethnicity (A, B, C, D, and E). We employed one-way ANOVA to compute the mean differences for race/ethnicity on academic achievement. The ANOVA was statistically significant across all three subject areas assessed. Race/ethnicity influences mathematics performance $F (4, 995) = 14.594$, $p < 0.01$. A significant difference, $F (4, 995) = 5.622$, $p < 0.01$, was observed between the various ethnic groups and academic achievement in reading and writing, $F (4, 995) = 7.162$, $p < 0.01$ (Table 8). The significant difference in means shows that the type/student's race/ethnicity is crucial to the student's academic performance. From the results, we concluded that race/ethnicity positively influences high school students' academic performance, and it can be argued that students from group E outperformed students in other groups in all areas assessed. The possible reason for differences in means could be that language, social and economic status, and other factors are implicit in ethnicity.

Table 13. Students' Race/Ethnicity and Academic Performance (One-Way ANOVA)

		Sum of Squares	df	Mean Square	F	Sig.
Maths score	Between Groups	12728.817	4	3182.204	14.594	0.000
	Within Groups	216960.262	995	218.051		
	Total	229689.079	999			
Reading score	Between Groups	4706.287	4	1176.572	5.622	0.000
	Within Groups	208246.152	995	209.293		
	Total	212952.439	999			
Writing score	Between Groups	6456.135	4	1614.034	7.162	0.000
	Within Groups	224220.949	995	225.348		
	Total	230677.084	999			

5. Discussions

This study examined the effect of parental education level, gender, and race/ethnicity on high school students' academic performance in mathematics, reading, and writing. The study revealed interesting results. First, it was found that parents' level of education influenced students' academic performance in the three areas assessed in the USA, and the influence was more likely to be positive; the higher the education level, the better the performance. This confirms the findings of past studies in similar fields (e.g., Benner, 2016; Bicer et al., 2013; Pinquart & Ebeling, 2020; Porumbu & Necșoi, 2013; Sharma & Jha, 2014; Younes et al., 2023). These studies revealed that parents' educational attainment and involvement influence students' academic achievement directly and indirectly through consistent communication, expectations, awareness of their children's academic progress, guidance on effective learning techniques, and providing essential resources such as books.

Robert (2003) found that parental academic level/interest and teacher-student relationships were associated with reading and mathematics performance (Baliyan et al., 2012; Bassani, 2006; Danişman, 2017; Khajehpour, 2011). Suggesting higher parental education levels might enhance parents' effectiveness as educators at home. This is because they are more likely to possess knowledge about their children's curriculum, enabling them to assist with homework and offer suitable cognitive stimulation during non-school hours. Well-educated parents are involved in supportive activities at home, such as reading and discussing school experience (Suizzo & Stapleton, 2007), practical supervision of assignments (Rowan-Kenyon et al., 2008), and parents with knowledge of the educational system involving themselves in their children's education (Antony-Newman, 2019a), contributing to students' academic success.

The significant t-statistics in this study demonstrate that parents play a crucial role in children's education. This finding is consistent with Odoh et al. (2017) and Sharma and Jha (2014), who revealed that students whose parents had higher education levels tended to achieve higher academic performance.

The findings for research hypothesis 2 indicated that students' gender significantly influenced their academic performance in mathematics, reading, and writing. While males surpassed females in mathematics, males' performance in writing and reading was lower than that of females. These results concur with the findings of previous studies, such as Nelson (2009), Renato (2016), Rahman et al. (2023), and Tsaousis and Alghamdi (2022) that there was a gender difference in academic achievement. The finding is also in line with studies (e.g., Spinath et al., 2010; Voyer & Voyer, 2014), who found that females performed better in language course tests, whereas males seem to do better in STEM-related subjects (Mullis et al., 2016; Spinath et al., 2010).

In contrast, Abubakar and Bada (2012), Ajai and Imoko (2015), and Sharma and Jha (2014) discovered that gender differences had no meaningful impact, as males and females displayed similar average academic performance scores. This suggests that males and females might have equal levels of knowledge development, but this will practically depend on the pedagogical approach.

The outcome of the last research hypothesis revealed that students' race/ethnicity has a significant role in academic performance. Though the study found race/ethnicity to predict academic performance, the analysis did not determine which race/ethnicity represents a native-born or immigrant group. However, it is anticipated that the mean difference could be impacted by challenges such as low parental level of education, language barrier, and lower income level, as identified in previous studies (e.g., Antony-Newman, 2019b; Lareau, 2011). For instance, Lareau (2011) affirmed that native-born groups receive the most substantial educational advantages for their children, thereby fostering academic success. The finding of this study also supports earlier studies by Cokley and Chapman (2008), Day and Dotterer (2018), Zewolde (2022), and Rucinski (2022), who found a strong effect between academic attainment, perceptions of academic capability, learning development, and the racial and ethnic diversity of student groups. Parental participation plays a crucial role in encouraging the enrollment of students, particularly among racial and ethnic communities that are underrepresented in higher education (Perna & Titus, 2005). While the results of this study revealed that race and ethnicity influence academic performance, the findings of Chiu et al. (2016) showed no significant difference between race and academic achievement.

6. Conclusion

This study confirmed our hypotheses that a student's academic performance is significantly influenced by demographic factors such as parental educational levels, gender, and race/ethnicity. This holds for pre-tertiary students across various subjects, including mathematics, reading, and writing, in the USA and potentially applies to other pre-tertiary institutions and different subject areas. This empirical analysis sheds light on the interplay between sociodemographic factors and academic achievement. The study contributes to the broader discourse on the gender gap in academic performance, ethnic equality, and educational inequality, highlighting areas where disparities may exist and suggesting avenues for addressing them.

The study offers insights that can inform educational policies and interventions to improve student outcomes. Thus, the findings hold significance for all education stakeholders (e.g. high school guidance departments, higher education institutions, the government, teachers, and parents) as pre-tertiary performance affects tertiary intake and performance. Pre-tertiary counselors should offer additional assistance or resources to students whose parents lack, at most, a college education. Correspondingly, colleges should collaborate with local high schools to assign mentors to students in this demographic category, aiming to recruit and effectively retain them (Chiu et al., 2016). The government should initiate support programs or resource allocation strategies tailored to address specific demographic challenges. For instance, the government should initiate a widespread awareness campaign to educate parents about the significance of education and support parental educational endeavors. Education stakeholders should provide equal support for students, irrespective of gender, aiming to balance academic performance across all subjects. Thus, these results benefit mathematics and language teachers by providing possible strategies to improve effective and thorough learning among females and males in all subjects, specifically mathematics and language. Educational stakeholders should promote unity and shared prosperity of all racial/ethnic groups to enhance quality education in racial/ethnic school areas. Finally, the government (host of the education system) should support native-born and immigrant groups equally by improving racial/ethnic educational policies, such as increasing investment in resources to achieve equal academic success. Only by implementing these strategies and those in the literature not covered in this study can we effectively address the

gender gap in academic achievement, promote equality in racial/ethnic education, and elevate parental involvement in education.

One limitation of the study was that we used secondary data instead of primary data; how the data were collected cannot be determined, which might impact the results. In the dataset, race/ethnicity was specified as Asian, African-American, Hispanic, or other and further grouped into five groups: Groups A, B, C, D, and E. We could not determine how this classification was performed or which group represented A and in that order. Therefore, the findings of this study could not specify which race/ethnicity had the highest score or was highly influenced by academic performance. Finally, it remains unclear whether the parents of the students were residing together or separately during the data collection period. Further research in this area or beyond can be done to address these limitations while including and assessing other potential factors.

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Notes

Author contributions

All authors (EA, EKD, AGA) contributed to the study's conception and design. Elizabeth Abugri wrote the first draft of the manuscript, and all the authors read and approved the final manuscript.

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Data Transparency

The authors used secondary data that is publicly available for research purposes at http://roycekimmons.com/tools/generated_data/exams

Declarations

Declarations of Originality

This submitted work is original and has not been published elsewhere in any form or language (partially or fully).

Conflict of interest:

The authors declare the absence of any competing interests.