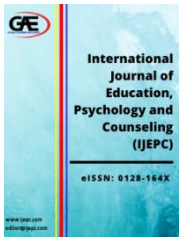
International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024



INTERNATIONAL JOURNAL OF EDUCATION, PSYCHOLOGY AND COUNSELLING (IJEPC)
www.ijepc.com

PREDICTIVE VALIDITY OF STUDENT AND SCHOOL VARIABLES: A MULTIPLE REGRESSION ANALYSIS ON DIVERSE STUDENTS' MATHEMATICS ACHIEVEMENT

Olukayode E. Apata[1*], Amin Raeisi-Vanani[2], Mehdi Nasri[3], Samson Ayo[4], Patrick Friday Obot[5]

[1] Department of Educational Psychology, Texas A&M University, United States
Email: apata.olukayode@tamu.edu
[2] Department of Educational Psychology, Texas A&M University, United States
Email: aminraeisivanani@tamu.edu
[3] Department of Educational Psychology, Texas A&M University, United States
Email: mehdinasri@tamu.edu
[4] School of Mathematics and Natural Sciences, University of Southern Mississippi, United States
Email: samson.ayo@usm.edu
[5] Curriculum and Instruction, University of Houston, United States.
Email: patrickfridayobot@gmail.com
[*] Corresponding Author

Article Info:

Article history:
Received date: 26.09.2023
Revised date: 18.10.2023
Accepted date: 26.11.2023
Published date: 14.12.2023

To cite this document:

Apata, O. E., Raeisi-Vanani, A., Nasri, M., Ayo, S., & Obot, P. F. (2023). Predictive Validity Of Student And School Variables: A Multiple Regression Analysis On Diverse Students' Mathematics Achievement. *International Journal of Education, Psychology and Counseling, 8* (52), 310-327.

DOI: 10.35631/IJEPC.852024

Abstract:

This study explored the relationship between race and math achievement, considering gender and the moderating effect of socioeconomic status (SES) in a diverse high school student sample (n=200) from the National Education Longitudinal Studies (NELS) program. Surprisingly, after controlling for gender, Hispanic students outperformed the reference group (White) in math scores, challenging previous assumptions. However, no significant differences were found for Asian and African American students. Contrary to existing literature, SES did not moderate the race-math achievement link. Similarly, when controlling gender, race, and SES, school type did not significantly affect math achievement. Among predictor variables, program type emerged as the most influential, highlighting the importance of educational programs in boosting math skills. Gender and school type had limited predictive power in determining math performance. In summary, this study exposes race-related math achievement disparities in diverse student populations and highlights the limited role of SES and school type in moderating these gaps. These findings provide valuable insights for educators and policymakers striving to address math achievement disparities and emphasize the necessity for further research into this intricate interplay of factors.

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

Keywords:

Gender, Mathematics Achievement, Race, Socioeconomic Status (SES), And School Type

Introduction

Mathematics is universally recognized as a critical cornerstone for progress in science, engineering, and technology. Its role in national development and as a key component in STEM education cannot be overstated. Despite this, mathematics achievement remains challenging for many students, leading to noticeable gaps and disparities in performance. This issue is particularly pronounced in diverse student populations where socioeconomic, racial, and school-related factors impact learning outcomes. In this context, it becomes imperative to understand the predictive validity of student and school variables on mathematics achievement. Previous research has explored various factors influencing students' performance in mathematics, yet there remains a gap in understanding these influences within diverse student populations. The generalizability of past findings to such populations is not well established, prompting the need for a more nuanced investigation. This study filled this gap by employing a multiple regression analysis to examine how different student and school variables predict mathematics achievement among a diverse cohort of students. Specifically, we explore the influences of socioeconomic status (SES), gender, and school type on mathematics achievement, considering the complex backdrop of racial and cultural diversity in the United States. Through this research, we provided valuable insights for educators, policymakers, and stakeholders in the educational sector. More effective strategies and interventions can be developed to support diverse student populations, ultimately contributing to more equitable educational outcomes in mathematics.

Literature Review

Mathematics is the bedrock upon which science, engineering, and technology are built. Apata (2019) stated that a strong background in mathematics is essential for building a solid foundation in physics and the STEM fields. Nevertheless, despite its importance, umpteen students still struggle with it, leading to achievement gaps and disparities in opportunities (Xin, 2019). Hence, it is particularly important to identify student and school variables that predict mathematics achievement so that educators and policymakers can adopt effective measures to enhance student performance. Previous research has explored factors affecting students' achievement in mathematics; nonetheless, there is a paucity of research on the generalizability of previous findings to diverse student populations. To delve deeper into this issue and understand the layers of academic accomplishment, it is essential to examine what exactly constitutes mathematics achievement and explore the socio-economic factors affecting it.

Mathematics achievement can be defined as the level of proficiency a student has attained in mathematics, as measured by their scores on standardized math tests (OECD, 2016). Research has consistently shown the existence of socio-economic status (SES)-related math achievement gaps that appear before the onset of formal schooling and widen during early childhood (Aunola et al., 2004; Starkey & Klein, 2008; Starky et al., 2022; Young et al., 2023). One possible explanation for this gap is that poor families have less access to resources needed to provide math-related support within the home, including less time to provide stimulating interactions to teach school readiness skills, like numbers and (math) language (Davis-Kean, 2005; Daucourt et al., 2021). This may be due to low-SES parents holding multiple jobs to make ends meet amid socioeconomic strain, leaving them with less discretionary time to spend

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

helping their children with math and communicating their math attitudes and expectations to their children (Lareau, 1987). Compared to low-SES parents, high-SES parents are also more likely to provide more math-related exchanges during playtime (Vandermaas-Peeler et al., 2009). Recent research by Weng and Luo (2022) also found that socioeconomic status was a significant moderator that influenced students' learning achievements in mathematics and science, confirming the results by Peng et al. (2021)

Similarly, gender differences in mathematics performance have been extensively studied, attracting public interest and academic research (Lu et al., 2023). Despite the underrepresentation of women in professional STEM fields, school-organized academic achievement assessments have consistently demonstrated only infinitesimal gender differences in mathematics achievements, or even a gender difference favoring girls (Lindberg et al., 2010). Large-scale international or within-country investigations and associated meta-analyses have further supported these findings, demonstrating trivial gender differences in mathematics performance (Hyde, 2005; Hyde et al., 2008; Hyde & Linn, 2006; OECD, 2010). The gender effect size, typically calculated as the mean for males minus the mean for females divided by the pooled within-gender standard deviation, is often close to zero ($d < 0.10$) or small ($0.11 < d < 0.35$). These results support the gender similarity hypothesis, signifying that male and female individuals perform similarly in mathematics (Hyde & Plant, 1995). Nonetheless, more research is necessary to give a more vivid picture on the role of gender and math achievement, especially given other contributing factors such as economic inequalities (see Lu et al., 2023). The exploration does not stop at the individual level; the type of educational institution, precisely the contrast between public and private schools, is another significant variable hypothesized to impact mathematics achievement.

Juxtaposing public and private schools in terms of academic achievement levels has been a topic of interest in many education systems. Early studies conducted in the 1980s found that private school students had significantly higher academic achievement levels than public school students (Coleman & Hoffer, 1987). However, researchers have since critiqued the methodology of these studies and called the role of students' demographic variables into question, leading to further research on the school effect. Subsequent studies have shown that the difference between achievement levels of public and private school students is not statistically significant when students' demographic and socioeconomic variables are controlled. For instance, Figlio and Stone (1997) found that early studies did not randomly sample schools and students, which was a major methodological deficiency. Goldhaber (1996) found that when controlling for students' socioeconomic status, there is no significant difference between public and private schools regarding mathematics and reading comprehension skills. Similarly, Scott et al. (1994) found no significant difference between students' growth in mathematics at public and private schools over two years. Lubienski and Lubienski (2006), using data from the 2003 National Assessment of Educational Progress, found that the difference between public and private school students' academic levels was not significant when controlling for students' socioeconomic status. The study analyzed data collected from 190,000 4th-grade students and 153,000 8th-grade students in the United States. Alongside the intricate dynamics of school types, another profound variable that is hypothesized to play a pivotal role in mathematics achievement is race, a multifaceted construct shaped by complex social, cultural, and historical contexts.

It is now widely accepted that the concept of race is a complex, social construct that is not based on biology. It is a multidimensional construct that is contextually specific to the time and

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

social-cultural-political context (Martinez et al., 2023). This complicated social construct has been shown to have an impact on educational outcomes. Research has shown that there are significant racial disparities in academic achievement, with students from certain racial and ethnic backgrounds consistently scoring lower on standardized tests than their peers from other racial and ethnic groups (Morgan et al., 2022). For example, in the United States, Black and Hispanic students have been shown to perform lower in mathematics compared to White and Asian students (Wai & Allen, 2019). While some scholars argue that these disparities can be attributed to socioeconomic status (SES), others suggest that race plays a significant independent role in shaping academic outcomes. In this study, we aim to explore the relationship between race and mathematics achievement among diverse student populations, while controlling for gender and SES, and examining the moderating effect of SES on this relationship.

Current Study and the Research Questions

The existing research has identified several factors contributing to differences in mathematics achievement levels among students, including socioeconomic status and gender. While the gender gap in mathematics performance appears to be relatively small, socioeconomic status has a more significant impact, with poor families having less access to resources that support math-related skills and readiness. Moreover, research on public versus private schools has shown that when controlling for demographic and socio-economic variables, the differences in academic achievement levels are not significant. However, exploring the complex and intricate relationship amongst socio-economic status, gender, and academic achievement in mathematics— particularly in terms of the potential underlying mechanisms that explain these differences—is still a research desideratum, especially through the lens of multiple-regressions and SEM (see Raeisi-Vanani, et al. 2022). This study aims to contribute to the existing literature by examining the factors that predict diverse student populations' achievement in mathematics, particularly in the context of student variables and school characteristics. We provided insights that could be useful for educators, policymakers, and other stakeholders in promoting equitable opportunities for students in mathematics. Against this backdrop, the current study seeks to answer the following research questions:

1. Controlling for gender, what is the relationship between race and mathematics achievement among diverse student populations, and how does SES moderate this relationship?
2. How does the school type (public and private) impact the achievement of students in mathematics, controlling for gender, race, and SES?
3. Which of the predictor variables has the strongest and weakest predictive power on mathematics achievement?

Hypothesis

The following null hypotheses guided our study:

1. There is no significant relationship between race and mathematics achievement among diverse student populations, controlling for gender, and SES does not moderate this relationship.
2. Null hypothesis for second Research Question: There is no significant difference in mathematics achievement between public and private school students, controlling for gender, race, and SES.

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

Variables of the Study

In the current research, the independent variables are gender, race, socioeconomic status, school type, and school program type (all categorical). The dependent variable is the scores in mathematics (continuous).

Justification for the Inclusion of the Control Variables

By controlling for gender in research question one, we ensure that any observed relationship between race and mathematics achievement is not due to gender differences, but it enables us to perform a more thorough investigation of the association between race and mathematics achievement among diverse student populations. Thus, gender is a potential confounding variable that we included to ensure the validity and reliability of our findings. For instance, even after controlling for variables like grades and SAT scores, a meta-analysis study by Hyde, Fennema, and Lamon (1990) discovered that male students performed better than their female counterparts in high school and college mathematics. Moreover, in research question two, we controlled for gender, race, and socioeconomic status to isolate the impact of school type (private or public) on students' mathematics achievement by considering the effects of other factors that have been shown to impact mathematics achievement.

Methods

A sample of 200 students was collected as a subset of the High School and Beyond study conducted by the National Education Longitudinal Studies (NELS) program of the National Center for Education Statistics (NCES). The 200-dataset sample was received from a professor affiliated with the Educational Research and Foundation, licensed to download data from the NCES database. The target population consisted of students who attended public and private high schools in the United States and were either in the 10th or 12th grades. The HSB data included over 28,000 high school sophomores and 30,000 high school seniors. It consisted of a survey that was conducted in 1980, which served as the benchmark, and additional follow-up surveys in 1982, 1984, 1986, and 1992.

To ensure the validity and reliability of the instrument, we used the dataset by the NELS program of the NCES, an organization recognized to be a relevant and dependable source of data on academic and professional outcomes. Missing data were absent in the dataset and did not need to be handled during the analysis. Thus, the impact of missing data on the appropriate interpretation of the results is irrelevant to our analysis.

To test for outliers, four regression diagnostics were run: leverage, studentized residuals, Cook's D, and DfBetas. We identified the most common outliers with frequencies four- or three times across all four methods, resulting in three outliers. The effect of the three outliers on the results was checked by performing the regression analysis with and without the outliers. When the outliers were removed, there was no substantial change in the regression analysis. Hence, we decided to retain the outliers in the final analysis.

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

Regression Models

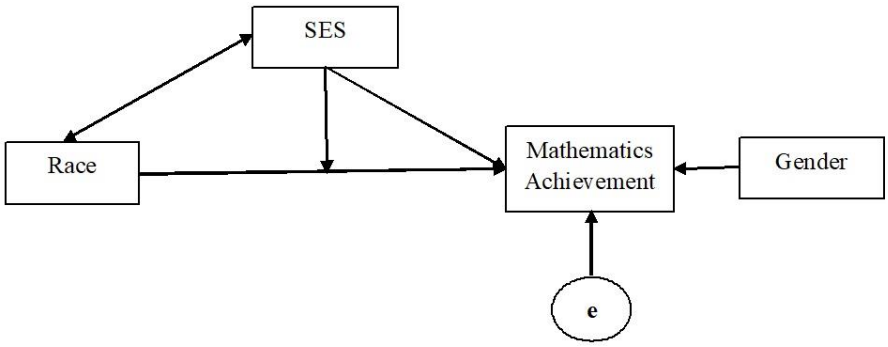


Figure 1: Regression Model Of Race, Socioeconomic Status, And Mathematics Achievement

The causal model for Research Question 1 is presented in Figure 1. Race and socioeconomic status (SES) are the independent and moderating variables. The dependent variable is mathematics achievement. The direction of the relationship among race, SES, and mathematics achievement is indicated with the arrows. We hypothesized that race predicts mathematics achievement. Another factor that potentially drives the relationship is the moderating variable parental income (SES), which means that its effect on the relationship between race and mathematics achievement depends on its level. Higher SES directly affords mathematics achievement because the resources available to the students for studying dictate greater cognitive ability. Furthermore, we hypothesized that students from certain races (e.g., White) would have higher SES compared to Hispanic or African American. The general regression equation is defined as follows:

Mathematics achievement = $b_0 + b_1$Race + b_2SES + b_3Race#SES + b_4Gender + **e**

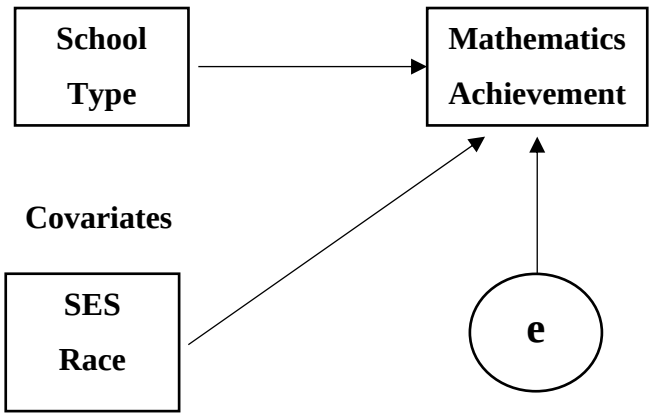


Figure 2: Regression Causal Model Of The Impact Of School Type On Mathematics Achievement

The causal model for Research Question 2 is presented in Figure 2. The direction of the arrow represents the causal relationship between school type and mathematics achievement. We held the variables gender, race, and SES constant to isolate their effect on school type while

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

predicting student mathematics achievement. The general regression equation for the causal model is:

Mathematics achievement = b_0 + b_1School type + b_2Gender + b_3Race + b_4SES + **e**

The causal model and general regression equation for the third research question is:

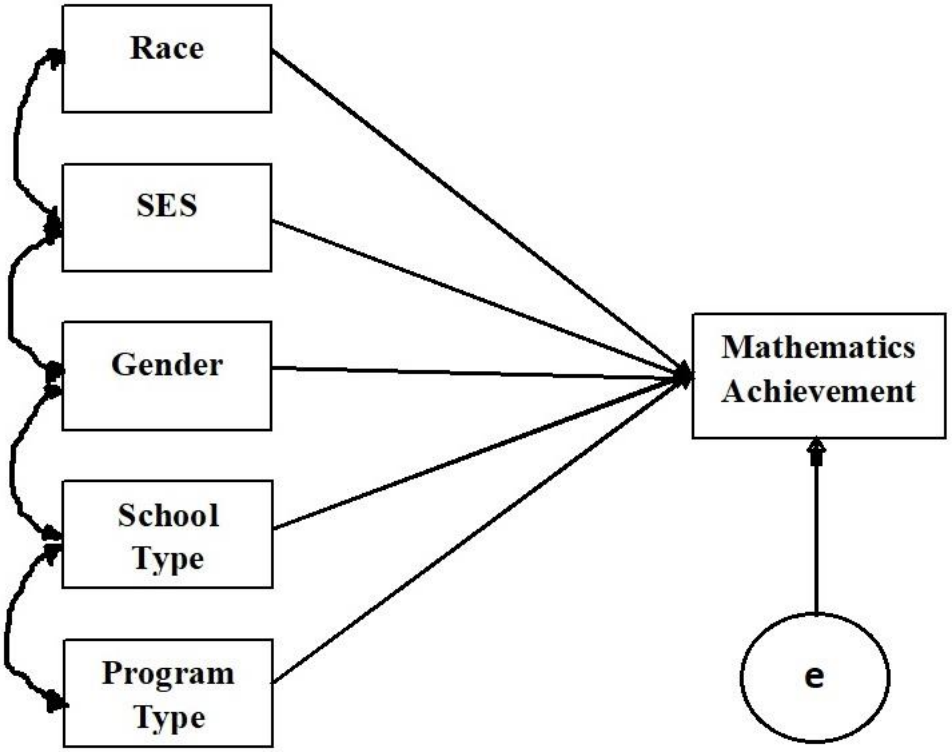


Figure 3: *Regression causal model of the impact of race, SES, gender, school type, program type on mathematics achievement*.

Mathematics achievement = b_0 + b_1Race + b_2SES + b_3Gender + b_4School type + b_5Program type + **e**

Results

Descriptive statistics for the five categorical predictors are presented in Table 1. Of the 200 participants, 54.5% were male and 45.5% were female. Most participants identified as African American (72.5%), followed by White (12.0%), Asian (10.0%), and Hispanic (5.5%). Approximately 29.0% of participants had high socioeconomic status, 47.5% had medium socioeconomic status, and 23.5% had low socioeconomic status. Most participants attended public schools (84.0%) rather than private schools (16.0%). Finally, most participants were enrolled in vocational programs (52.5%), followed by academic programs (25.0%) and general programs (22.5%).

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

Table 1
Descriptive Statistics of the Predictors

Predictors	Category	N	Proportions	M	SD
Gender	Female	91	45.5%	-	-
	Male	109	54.5%	-	-
Race	African-American	145	72.5%	-	-
	Asian	20	10.0%	-	-
	Hispanic	11	5.5%	-	-
	White	24	12.0%	-	-
Socioeconomic State	Low	47	23.5%	-	-
	Medium	95	47.5%	-	-
	High	58	29.0%	-	-
School Type	Public	168	84.0%	-	-
	Private	32	16.0%	-	-
Program Type	General	45	22.5%	-	-
	Vocation	105	52.5%	-	-
	Academic	50	25.0%	-	-

Note: In the table, "-" indicates that the mean and standard deviation were not reported for categorical variables.

Assumption Checking

After running regression diagnostics, we determined that the normality of residuals, homoscedasticity, and heteroskedasticity assumptions were tenable. We did not test for the correct specification of the form of the relationship because all our predictors are categorical variables. To determine the normality of residuals, we generated density and QQ plots. Both distributions were close to normal. Additionally, skewness (0.19) was close to 0, and kurtosis (2.75) was close to 3. A residual vs. fitted plot was generated to determine if the residual assumption's constant variance was met. For most of the distribution, the dispersion of the residuals appears to be constant across all fitted values. Therefore, it is reasonable to assume that the homoscedasticity assumption was met. Also, the Breusch-Pagan test was not significant ($\chi 2$ (1) = 2.77, p = 0.0962), indicating that the constant residual assumption is tenable. Therefore, because the three assumptions were met, the Ordinary Least Squares (OLS) estimation method was used.

Research Question 1: Controlling for gender, what is the relationship between race and mathematics achievement among diverse student populations, and how does SES moderate this relationship?

Table 2 shows the results of the multiple regression analysis performed to examine the relationship between race and mathematics achievement while holding gender constant and moderating effect of SES among diverse student population. The data was collected from 200 students who participated in the High School and Beyond study conducted by the National Education Longitudinal Studies (NELS) program of the National Center for Education Statistics (NCES). The obtained R^2 value was .162, suggesting that the model with race and SES as predictors accounted for 16.20% of the variance in mathematics achievement. Accounting for the number of predictors, the adjusted R^2 of variance explained is 10.8%. The value of adjusted R^2 indicates that the model does not adequately explain the variation in mathematics achievement. This implies that the model needs to be improved. The F-test shows

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

that the model explained a statistically significant variation in mathematics achievement, [F (12, 187) = 3.01, *p*=0.0007).

Controlling for gender, the results in Table 2 show that scores on mathematics achievement varied significantly by racial group. Compared to other students in the racial group, students from Hispanic backgrounds had better mathematics achievement scores (b=16.44, t=2.79, *p*=0.006). However, there were no significant differences between Asians **(b=**0.065, t=0.020, p=0.987) and African American students (b=5.649, t=1.630, p=1.630) and the reference group (White). Furthermore, socioeconomic status did not predict mathematics achievement. Medium SES (b=1.93, t=0.48, p=0.6290) and High SES (b=7.74, t=1.45, p=0.149) have a p-value greater than 0.05. Therefore, there was no evidence to support the assertion that SES moderated the relationship between race and mathematics achievement.

Moreover, the interaction plot in Figure 4 exhibits the interaction plot that displayed the predicted values of mathematics performance for different combinations of race, socioeconomic status, and gender. The vertical axis represents the predicted math performance scores, and the horizontal axis represents the various categories of races. The plot represents the levels (i.e., low, medium, and high) of SES for White students and shows the predicted mathematics achievement for gender for each level of SES. The predicted mathematics achievement scores are 45, 47, and 53, respectively. The interaction plot also displays the three levels of SES and the predicted mathematics achievement for gender (male students) at each level of the SES for Hispanic students. The predicted mathematics achievement scores for low, medium, and high are 55, 56.5, and 62, respectively. The Hispanic males with low SES data points have a predicted mathematics performance score of 62, suggesting they have the highest mean math score out of all the groups plotted. The figures are higher than White, Asian, and African American students.

Table 3 shows the effect size of the predictors (race, SES, and gender) and the interaction effect of race and SES. The overall model's effect size was large, with an eta-squared of .16 (95% CI [.032, .207]). Among the individual predictors, race had a medium effect size with an eta-squared of .07 (95% CI [.009, .139]), while SES had a small effect size with an eta-squared of .01 (95% CI [0, .045]). Gender had a negligible effect size with an eta-squared of .000 (95% CI [0, .009]). The interaction between race and SES had a small effect size with an eta-squared of .01 (95% CI [0, .028]).

Table 2
Results of Multiple Regression Analysis of Race, SES, and Mathematics Achievement

Predictors	B(S.E.)	T	P
Intercept	45.285 (3.073)	14.740	<0.001
Race			
Hispanic	16.444 (5.898)	2.790	0.006
Asian	0.065 (3.981)	0.020	0.987
African-American	5.649 (3.458)	1.630	0.104
SES			
Medium	1.931 (3.996)	0.480	0.629
High	7.738 (5.334)	1.450	0.149
Gender	-0.095 (1.296)	-0.070	0.942

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

Race#SES			
Hispanic#Medium	-8.604 (7.593)	-1.130	0.259
Hispanic#High	-12.707 (9.022)	-1.410	0.161
Asian#Medium	0.917 (6.002)	0.150	0.879
Asian#High	-3.692 (7.848)	-0.470	0.639
African American Medium	0.295 (4.497)	0.070	0.948
African American#High	-1.794 (5.769)	-0.310	0.756

Table 3
***Effect Sizes* For The Race, SES, Gender, And Race#SES On Mathematics Achievement Of Students**

Source	Eta-squared	Df	[95% conf. interval]	
Model	0.16	12	.0322	.207
Race	0.07	3	.0092	.129
SES	0.01	2	.	.045
Gender	0.00	1	.	.009
Race#SES	0.01	6	.	.028

Note: Eta-squared values for individual model terms are partial.

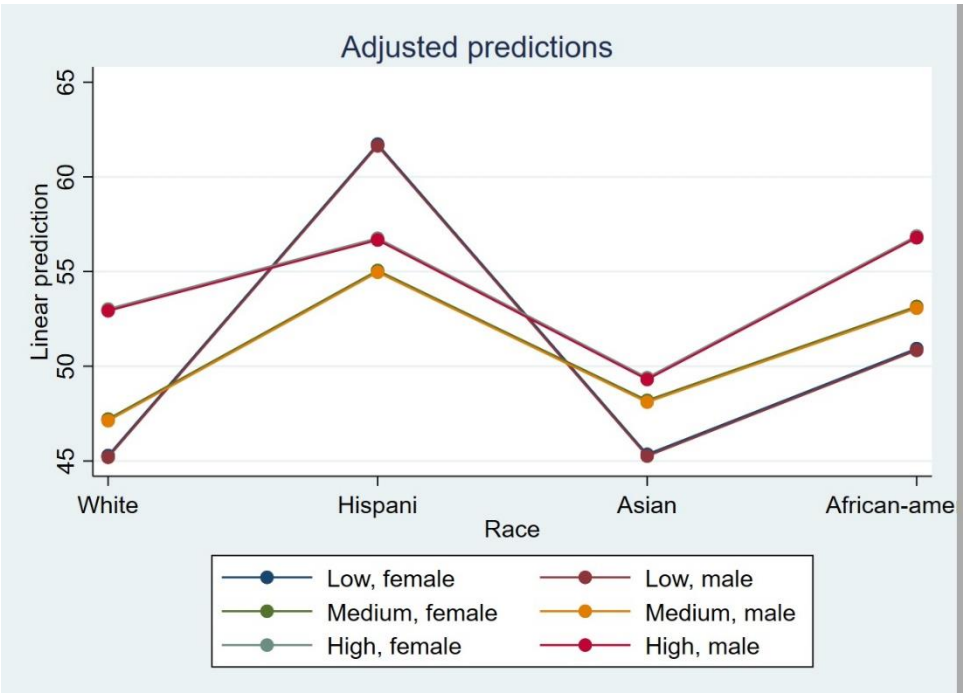


Figure 4: Interaction Plot For The Predicted Values Of Mathematics Performance For Different Combinations Of Race, Socioeconomic Status, And Gender.

Research Question 2: How does the school type (public and private) impact students' achievement in mathematics, controlling for gender, race, and SES?

Table 4 shows the regression analysis of mathematics achievement on school type (private and public) and the moderating effects of gender, race, and SES. The reference groups (White). for the categorical predictors (school type, gender, race, and SES) are public, female, White, and

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

low, respectively. The obtained R^2 value was .153, suggesting that the model with school type as the focal variable accounted for 15.3 % of the variance in mathematics achievement. Accounting for the number of predictors, the adjusted R^2 of variance explained is 12.16%. The value of adjusted R^2 indicates that the model does not adequately explain the variation in mathematics achievement. This implies that the model needs to be improved. The F-test shows that the model explained a statistically significant amount of variation in mathematics achievement, [F (7, 192) = 4.93, p<.001). The root mean square error was 8.78, indicating the average difference between the predicted and actual mathematics achievement scores. Controlling for gender, race, and SES, a 1 point higher in school type is predicted to have a 1.466 point higher in mathematics achievement. However, the slope for the essay is not statistically significant [t (192) = 0.85, p = 0.397], indicating that school type does not significantly contribute to students' mathematics achievement.

Table 5 shows the effect size of the predictors (school type, gender, race, and SES). The overall model's effect size was large, with an eta-squared of .15 (95% CI [.046, .218]). Among the individual predictors, race had a medium effect size with an eta-squared of .08 (95% CI [.014, .150]), while SES had a small effect size with an eta-squared of .05 (95% CI [.002, .109]). Gender and School Type had a negligible effect size with an eta-squared of .000 (95% CI [0, .009]).

Table 5 Results of the Regression Analysis for of Mathematics Achievement on School Type, Gender, Race, and SES

Predictors	B	SE	T	P
Intercept	45.98***	2.16	21.30	<0.001
School Type				
Public				
Private	1.47*	1.73	0.85	0.397
Gender				
Female				
Male	-0.34	1.27	-0.27	0.790
Race				
White				
African American	5.54**	1.97	2.81	0.006
Asian	-0.33	2.68	-0.12	0.904
Hispanic	9.41***	3.22	2.92	0.004
SES				
Low				
Medium	1.37	1.66	0.83	0.410
High	5.02*	1.83	2.75	0.007

Note: * p < .05, ** p < .01, *** p < .001

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

Table 5
***Effect Sizes* For School Type, Gender, Race, And SES On Mathematics Achievement Of Students**

Source	Eta-squared	Df	[95% conf. interval]	
Model	0.15	7	.046	.218
School Type	0.00	1	.	.039
Gender	0.00	1	.	.022
Race	0.08	3	.014	.150
SES	0.05	2	.002	.109

Note: Eta-squared values for individual model terms are partial.

Research Question 3: Which of the predictor variables has the strongest and weakest predictive power on mathematics achievement?

Table 6 shows the hierarchical regression analysis predicting high school students' mathematics achievement. According to the findings, adding each predictor to the models led to significant changes in the R2 and F statistics, indicating their roles in predicting students' mathematics achievement. From the Table, program type has the strongest predictive power on mathematics achievement. It significantly increased the variance explained in the mathematics achievement from 15.2% to 32.1% ($\Delta R^2 = 0.169$, $F (2, 190) = 23.602$, $p < 0.001$). This accounts for the highest amount of variance in mathematics achievement. The weakest predictor variables were gender and school type, which did not significantly affect the models' R^2 values ($R^2 = 0.001$, $F (1, 190) = 0.176$, $p = 0.676$ and $R^2 = 0.001$, $F (1, 190) = 0.238$, $p = 0.626$, respectively). This suggests that these factors have little to no ability to predict how well students will perform in mathematics. In summary, we found out that program type is the best and strongest predictor of mathematics achievement of students, while school type and gender were the weakest predictors of mathematics achievement of students. The predictive power of race ($R^2 = 0.061$, $F (3, 190) = 5.663$, $p = 0.001$) was moderate and significant, but the predictive power of SES ($R^2 = 0.011$, $F (2, 190) = 1.607$, $p = 0.203$) was weak and non-significant.

Table 6
Results Of Hierarchical Multiple Regression Analysis Predicting Mathematics Achievement Of Students

Predictor	Model	R^2	F (df1)	P	ΔR^2	ΔF (df2)	P
Race	1	0.260	11.327 (6,193)	<.001			
	2	0.321	9.987 (9,190)	<.001	0.061	5.663 (3,190)	0.001**
SES	1	0.310	12.303 (7,192)	<.001			
	2	0.321	9.987 (9,190)	<.001	0.011	1.607 (2,190)	0.203
Program Type	1	0.152	4.935 (7,192)	<.001			
	2	0.321	9.987 (9,190)	<.001	0.169	23.602 (2,190)	<.001***
School type	1	0.320	11,250 (8,191)	<.001			

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

	2	0.321	9.987 (9,190)	<.001	0.001	0.238 (1,190)	0.626
Gender	1	0.321	11,262 (8,191)	<.001			
	2	0.321	9.987 (9,190)	<.001	0.001	0.176 (1,190)	0.676

* p < 0.05, ** p < 0.01, *** p < 0.001.

Note: R^2 is the coefficient of determination, and df1 is the degrees of freedom for the model and error, respectively. F-value and p-value represent the statistical significance of the model. ΔR^2 and ΔF are the change in R^2 and F-value when the predictor is added to the model, respectively. Df2 represents the degrees of freedom for the change in the model and error, respectively.

Discussion

The present study aimed to scrutinize the relationship between race and mathematics achievement, controlling for gender and moderating the effect of SES, among a diverse student population. To this end, a multiple linear regression analysis was used to analyze the data collected from 200 high school students who participated in the High School and Beyond study conducted by the National Education Longitudinal Studies (NELS) program of the National Center for Education Statistics (NCES). The *R*2 value of 0.162 suggests that the model with race and SES as predictors accounted for 16.20% of the variance in mathematics achievement. However, the adjusted R2 value of 0.108 indicates that the model needs to be improved to explain the variation in mathematics achievement.

The results for the first research question indicate a significant difference in mathematics achievement scores by racial group after controlling for gender. Specifically, students from Hispanic backgrounds had better mathematics achievement scores than the reference group (White). However, there were no significant differences between Asians and African American students and the reference group. These findings suggest that the relationship between race and mathematics achievement may be more complex than previously thought. It may be useful to explore other factors that could explain the differences in mathematical achievement among different racial groups.

The finding that Hispanic students outperformed other racial groups in mathematics achievement is consistent with previous research that has shown Hispanic students' relatively high academic achievement in mathematics compared to African American and White students (Farkas et al., 2003). One possible explanation for this finding is the cultural emphasis placed on education within the Hispanic community, which may contribute to their relatively high academic achievement in mathematics (Perez et al., 2010). Future research could explore the factors contributing to Hispanic students' academic success in mathematics to inform educational policy and practice.

The results of this study also indicate that SES does not play a significant role in moderating the relationship between race and mathematics achievement. This finding is inconsistent with previous research showing that SES is an important factor influencing academic achievement (Reardon, 2011; Weng & Luo, 2022). The study's small sample size and the specific demographic characteristics of the sample may have contributed to this finding. Future research with larger and more diverse samples could investigate the moderating effect of SES on the relationship between race and mathematics achievement.

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

The results of the second research question showed that school type did not significantly impact mathematics achievement when controlling for gender, race, and SES. This finding contradicts previous studies that reported private school students performing better in mathematics than their public-school counterparts (e.g., Borman & Dowling, 2010; Dee, 2004). However, it is essential to note that the present study included a diverse student population, while some previous studies focused on specific subgroups of students.

It is worth noting that the models' adjusted R2 values suggest that the current model does not adequately explain the variation in mathematics achievement, indicating that other factors not included in the model may impact mathematics achievement. For instance, other demographic factors such as parental education and occupation, student motivation, and quality of instruction may play a role in students' mathematics achievement (Gunderson et al., 2013; Meece et al., 2006).

As for the third research question, the present study examined the predictive power of various demographic factors on high school students' mathematics achievement. Our findings indicate that program type has the strongest predictive power on mathematics achievement, while gender and school type have the weakest predictive power. These results provide valuable insight into the factors that can affect students' performance in mathematics and have important implications for educators and policymakers.

The finding that program type has the strongest predictive power on mathematics achievement suggests that the educational programs in which students participate are essential in determining their mathematical performance. Specifically, students enrolled in advanced programs or those with a stronger emphasis on mathematics education tend to perform better in mathematics. Therefore, educators and policymakers should prioritize developing and implementing effective educational programs to enhance students' mathematical skills.

Interestingly, the results also indicate that race has a moderate predictive power on mathematics achievement, which suggests that students' ethnic backgrounds may influence their mathematical performance to some extent. While the reasons behind this finding are unclear from this study, cultural differences or experiences with discrimination may play a role. Therefore, further research should investigate the mechanisms underlying this association to provide a more comprehensive understanding of the factors contributing to the mathematics achievement gap.

On the other hand, our results show that gender and school type have minimal predictive power on mathematics achievement, which suggests that these factors may not be significant determinants of students' performance in mathematics. This finding is consistent with some previous research that has found little evidence for gender differences in mathematical ability and suggests that school type may not be as important as other factors in influencing students' mathematical performance. However, it is important to note that these results should be interpreted with caution, as they are based on a specific sample of high school students, and further research is needed to confirm these findings.

Conclusion, Limitations, and Further Research

The present study proffers valuable insights into the relationship between race and mathematics achievement while controlling for gender and the moderating effect of SES. The findings unveiled that socioeconomic status does not moderate the relationship between race and

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

mathematics achievement. The study also found that school type does not significantly impact mathematics achievement. The study's results contribute to the ongoing discussion of the achievement gap and the need to address disparities in mathematics achievement among diverse student populations. However, further research is needed to explore the reasons for these disparities and identify effective strategies to address them.

In terms of implications, this study provides important insights into the relationship between race, socioeconomic status (SES), and mathematics achievement among diverse student populations. The findings suggest that while students from Hispanic backgrounds may have better mathematics achievement scores than other racial groups, SES does not have a significant moderating effect on this relationship. These results may inform educators and policymakers in designing interventions and programs to enhance mathematics achievement among diverse student populations, with particular attention to Hispanic students.

Nevertheless, this study has several limitations that need to be acknowledged. First and foremost, the sample size was relatively small, with only 200 students. Therefore, caution must be taken in generalizing the results to larger populations. Second, the data used in this study was collected from the High School and Beyond study conducted by the National Education Longitudinal Studies (NELS) program of the National Center for Education Statistics (NCES). The results may not apply to other countries or educational systems.

As for new research areas, future studies may focus on examining other potential moderators of the relationship between race and mathematics achievement, such as parental involvement, teacher quality, and school resources. Moreover, further research may investigate the impact of cultural factors and beliefs on mathematics achievement among different racial groups. Furthermore, given the bulk of research accumulated on math achievements and its corollaries, there are some more advanced statistical techniques such as meta-regression and meta-SEM (Raeisi-Vanani et al., 2022) that can be used to provide a better understanding about the intricate relationship of the constructs probed in the present study.

Acknowledgment
We would like to thank the editor and the anonymous reviewers of this journal.

References

Apata, O. E. (2019). Predictive validity of school and student factors on secondary school students. *IOSR Journal of Research & Method in Education (IOSR-JRME),* 9(5), 35-42.

Aunola, K., Leskinen, E., Lerkkanen, M.-K., & Nurmi, J.-E. (2004). Developmental Dynamics of Math Performance from Preschool to Grade 2. *Journal of Educational Psychology, 96*(4), 699–713. https://doi.org/10.1037/0022-0663.96.4.699

Borman, G. D., & Dowling, N. M. (2010). Schools and inequality: A multilevel analysis of Coleman's equality of educational opportunity data. *Teachers College Record*, *112*(5), 1201-1246.

Brown-Jeffy, S. (2009). School Effects: Examining the Race Gap in Mathematics Achievement. *Journal of African American Studies*, *13*, 388-405.

Coleman, J. S., & Hoffer, T. (1987). *Public and private high schools*: The impact of communities. Basic Books.

Coleman, J. S., Hoffer, T., & Kilgore, S. (1982). *High school achievement: Public, Catholic, and private schools compared*. Basic Books.

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

Daucourt, M. C., Napoli, A. R., Quinn, J. M., Wood, S. G., & Hart, S. A. (2021). The home math environment and math achievement: A meta-analysis. *Psychological Bulletin, 147*(6), 565–596. https://doi.org/10.1037/bul0000330

Davis-Kean, P. E. (2005). The influence of parent education and family income on child achievement: The indirect role of parental expectations and the home environment. Journal of Family Psychology, 19 (2), 294–304. https://doi.org/10.1037/0893-3200.19.2.294

Dee, T. S. (2004). Are there civic returns to education? *Journal of Public Economics, 88*(9-10), 1697-1720.

Farkas, G., Foleno, T., & Burchinal, M. (2003). The relations of academic and social experiences to elementary school students' academic achievement. *Journal of Educational Psychology*, *95*(1), 88–103. https://doi.org/10.1037/0022-0663.95.1.88

Figlio, D. N., & Stone, J. A. (1997). School choice and student performance: Are private schools really better. Institute for Research on Poverty. https://www.researchgate.net/profile/Joe-Stone3/publication/286267327_Are_Private_Schools_Really_Better/links/5c6dad5792851c1c9df127bd/Are-Private-Schools-Really-Better.pdf

Hyde, J. S., Fennema, E., & Lamon, S. J. (1990). Gender differences in mathematics performance: A meta-analysis. *Psychological Bulletin, 107*(2), 139–155. https://doi.org/10.1037/0033-2909.107.2.139

Lu, Y., Zhang, X., & Zhou, X. (2023). Assessing gender difference in mathematics achievement. *School Psychology International*, *0*(0). https://doi.org/10.1177/01430343221149689

Figlio, D. N., & Stone, J. A. (1997). Can public schools learn from private schools? Case studies in the public and private non-profit education sectors. *The economics of choice, 1*, 33-62.

Gándara, P., & Contreras, F. (2009). *The Latino education crisis: The consequences of failed social policies.* Harvard University Press.

Goldhaber, D. (1996). Public and private high schools: The impact of communities revisited. *Sociology of Education*, *69*(3), 162-181.

Gunderson, E. A., Ramirez, G., Beilock, S. L., & Levine, S. C. (2013). The relation between spatial skill and early number knowledge: The role of the linear number line. *Developmental Psychology, 49*(8), 1-16.

Hyde J. S. (2005). The gender similarities hypothesis. *American Psychologist, 60(*6), 581–592. https://doi.org/10.1037/0003-066x.60.6.581

Hyde J. S., Lindberg S. M., Linn M. C., Ellis A. B., Williams C. C. (2008). Diversity. Gender similarities characterize math performance. *Science, 321*(5888), 494–495. https://doi.org/10.1126/science.1160364

Hyde J. S., Linn M. C. (2006). Gender similarities in mathematics and science. *Science, 314*(5799), 599–600. https://doi.org/https://doi.org/10.1126/science.1132154

Kenney-Benson, G. A., Pomerantz, E. M., Ryan, A. M., & Patrick, H. (2006). Sex differences in math performance: The role of children's approach to schoolwork. *Developmental Psychology 42*(1), 11.

Lareau, A. (1987). Social class differences in family-school relationships: The importance of cultural capital. *Sociology of Education, 60* (2), 73–85. https://doi.org/10.2307/2112583

Lindberg, S. M., Hyde, J. S., Petersen, J. L., & Linn, M. C. (2010). New trends in gender and mathematics performance: A meta-analysis. Psychological Bulletin, 136(6), 1123–1135. https://doi.org/10.1037/a0021276

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

Lubienski, C., & Lubienski, S. T. (2006). *Charter schools, achievement gaps, and the future of public education*. Routledge.

Martinez, R. A., Andrabi, N., Goodwin, A. N., Wilbur, R. E., Smith, N. R., & Zivich, P. N. (2023). Conceptualization, Operationalization, and Utilization of Race and Ethnicity in Major Epidemiology Journals, 1995–2018: A Systematic Review. *American Journal of Epidemiology, 192*(3), 483-496. https://doi.org/10.1093/aje/kwac146

Meece, J. L., Wigfield, A., & Eccles, J. S. (2006). Predictors of math anxiety and its influence on young adolescents' course enrollment intentions and performance in mathematics. Journal of Educational Psychology, 98(3), 485-495.

Morgan, P. L., Hu, E. H., Farkas, G., Hillemeier, M. M., Maczuga, S., & Gloski, C. A. (2022). Racial and ethnic disparities in advanced science and mathematics achievement during elementary school. *Educational Researcher, 67*(2), 76-88. https://doi.org/10.3102/0013189X2110282

OECD. (2016). PISA 2015 results in focus. Retrieved from https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf

Peng P., Wang T. F., Wang C. C., Lin X. (2019). A meta-analysis on the relation between fluid intelligence and reading/mathematics: Effects of tasks, age, and social economics status. *Psychological Bulletin, 145(2)*, 189–236. https://doi.org/10.1037/bul0000182

Perez, T., Taylor, K., & Garcia, E. (2010). Understanding the diverse educational experiences of Hispanic students: A critical review of the literature. *Review of Educational Research*, *80*(3), 401–455. https://doi.org/10.3102/0034654310377085

Raeisi-Vanani, A., Plonsky, L., Wang, W., Lee, K., & Peng, P. (2022). Applying meta-analytic structural equation modeling to second language research: An introduction. *ResearchMethods in Applied Linguistics, 1*(3), 100018. https://doi.org/10.1016/j.rmal.2022.100018

Reardon, S. F. (2011). The widening academic achievement gap between the rich and the poor: New evidence and possible explanations. In G. J. Duncan & R. J. Murnane (Eds.), Whither opportunity? Rising inequality, schools, and children's life chances (pp. 91-116). Russell Sage Foundation.

Scott, L.A., Rock, D.A., Pollack, J.M., & Ingels, S.J. (1994). Two years later: Cognitive gains and school transitions of NELS:88 eighth graders. U.S. Department of Education-National Center for Education Statistics, Statistical Analysis Report.

Scott, J. B., Ingels, S. J., & Owings, J. A. (1994). Public and private schools: How do they differ? Findings from the condition of education 1994 (NCES No. 94-724). US Department of Education, National Center for Education Statistics.

Starkey, P., & Klein, A. (2008). Sociocultural influences on young children's mathematical knowledge. In O. N. Saracho & B. Spodek (Eds.), Contemporary perspectives on mathematics in early childhood education (pp. 253–276). Information Age Publishing.

Starkey, P., Klein, A., Clarke, B., Baker, S., & Thomas, J. (2022). Effects of early mathematics intervention for low-SES pre-kindergarten and kindergarten students: a replication study. Educational Research and Evaluation, 27(1-2), 61-82. https://doi.org/10.1080/13803611.2021.2022316

Young, J. M., Reed, K. E., Rosenberg, H., & Kook, J. F. (2023). Adding family math to the equation: Promoting Head Start preschoolers' mathematics learning at home and school. *Early Childhood Research Quarterly, 63*, 43-58. https://doi.org/10.1016/j.ecresq.2022.11.002

Vandermaas-Peeler, M., Nelson, J., Bumpass, C., & Sassine, B. (2009). Numeracy-related exchanges in joint storybook reading and play. *International Journal of Early Years Education, 17*(1), 67–84. https://doi.org/10.1080/09669760802699910

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 8 Issue 52 (December 2023) PP. 310-327
DOI 10.35631/IJEPC.852024

Wai J., Allen J. (2019). What boosts talent development? Examining predictors of academic growth in secondary school among academically advanced youth across 21 years. *Gifted Child Quarterly, 63*(4), 253–272. https://doi.org/10.1177/0016986219869042

Weng, W. & Luo, W. (2022). Exploring the Influence of Students' ICT Use on Mathematics and Science Moderated by School-Related Factors. *Journal of Computers in Mathematics and Science Teaching, 41*(2), 163-185. Waynesville, NC USA: Association for the Advancement of Computing in Education (AACE). Retrieved April 21, 2023 from https://www.learntechlib.org/primary/p/220684/

Zhang, D., Lin, F., & Sun, H. (2017). Public versus private school performance in a standardized test: Is it the students or the school?. *Education Policy Analysis Archives, 25*(73), 1-25.