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Academic Achievement and Socioeconomic Status: Results of the Brazilian National High School Examination

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***Abstract* – The objective of this research is to evaluate the impact of socioeconomic factors on the performance of high school students who completed the National High School Examination (ENEM) in the last five years in the micro-region of the Middle Valley of the Paraíba River in the State of Rio de Janeiro, Brazil. The methodology used is descriptive statistics. Parental education levels and family income were selected as socioeconomic variables. In the data analysis, a qualitative methodology was used. The results show that there is a correlation between socioeconomic factors and the students' final grades, with approximately 16% of the influence of the independent variables on the dependent variable (R^2 = 0.16). The research verified that among the independent variables, family income has the strongest correlation, followed by maternal education. Empirical evidence suggests that policies in favor of increasing education for females could contribute to the improvement of students' academic performance without the conflicts that redistributive policies tend to bring.**

***Keywords* – Academic; Achievement; Socioeconomic; status; SAT.**

I. Introduction

The theme of this research is the impact of socioeconomic factors on the performance of high school students who completed the National High School Examination (ENEM) within the last five years in the micro-region of the Middle Valley of the Paraíba River in the State of Rio de Janeiro, Brazil

The micro-region is defined in Article 2 of State Law n. 3918/2002 and is formed by the following municipalities: Volta Redonda, Barra Mansa, Barra do Piraí, Piraí, Pinheiral, Valença, Resende, Porto Real, Quatis, Itatiaia, Rio das Flores and Rio Claro.

This micro-region is the second most important region of the state, behind only the metropolitan region. The average per capita gross domestic product of the micro-region was U.S. $20,779.00 per year in 2014, while the Brazilian GDP was U.S. $12,103.00. In 2016, the cities in the micro-region had a total of 882,668 inhabitants, amounting to approximately 13% of the state's population.

It was defined as a working hypothesis that socioeconomic factors such as family income and parental education impact student performance on the ENEM, resulting in higher grades for students who come from families with higher incomes and greater educational achievements.

For educational public policymakers, understanding the factors that have an impact on academic outcomes is very important. A country with extreme income inequality such as Brazil presents public administrators with an additional challenge to establish effective policies without creating social conflicts. Data from the National Continuous Household Survey (in Portuguese, PNAD) show that in 2017, the income of the richest 1% of the population was 36 times higher than the average income of the poorest 50%. In 2017, the 10% of the population with the highest incomes accounted for 43% of the country's total income, while the 10% with the lowest incomes accounted for only 0.7%.

The article is divided into two parts: The first part consists of a review of the international literature pertinent to the topic addressed, as well as a brief history of the ENEM, while the second part presents the results of the research, with emphasis on descriptive statistics.

Academic work in Brazil that takes a statistical approach to this subject is scarce [1] [2]. The main advantage of using quantitative methods is that they make the core of the discussion more clear and discrete, avoiding the risk of separating the theoretical foundation from the empirical data. In addition, the use of quantitative methods allows international comparisons.

This research is expected to raise questions that may eventually become hypotheses for future research: Does the impact of socioeconomic factors on academic performance vary according to the degree of a country's development? In other words, do countries with higher levels of development show the same levels of correlation between socioeconomic factors and academic performance as poorer countries?

This is a challenge to policymakers since the public policy literature points out that redistributive policies tend to increase social conflicts. [3][4][5]

Empirical research often turns out to be counterintuitive in its results, and as will be seen later, it has been discovered that the difference between the surveyed region and the United States, for example, is not as great as common sense might suppose.

II. Income, Poverty and Academic Performance

University admission tests have broad support in research as predictors of subsequent academic performance or academic achievement, and the role of socioeconomic status remains the focus of considerable academic attention [6] [7] [8].

As a result, family income and other indicators of socioeconomic status have been the subject of several educational studies [9] [10] [11] [12] [13] [14] [15] [16]

[17] [18] [19]. Blau [20] found a positive correlation between permanent income (the average income for several years) and performance in several tests, using data from the National Longitudinal Survey of Youth (NLSY).

Studies consistently point to the positive effects of income on academic achievement, including studies using data originating outside of the United States. Aughinbaugh and Gittleman [21], for example, used data from the NLSY and the National Child Development Study of Great Britain to examine the effects of income on academic achievement. Their results indicate that the relationship between income and test performance is similar to that reported in the United States. Similar findings have also been reported in Canada, using the National Longitudinal Survey of Canadian Youth by Dooley and Stewart [22].

The Scholastic Aptitude Test, or as it is better known – the SAT - is one of the most common college entrance exams in the United States, used by American universities in their undergraduate admissions processes and always occupying a prominent position in academic research on school performance.

Many critics maintain, however, that tests such as the SAT serve merely as "wealth tests"[23] [24] and that data would consistently reveal that all cognitive measures are related to socioeconomic status. Although most studies have found positive effects of higher incomes on academic development, Mayer's [25] paper provides a more complex picture. Using NLSY data, Mayer argues that differences between parents are not limited to income, but also include differences in enthusiasm, ability, academic skills and motivation, suggesting a spurious correlation between income and academic performance. In short, for that author, social and emotional differences account for variance in the academic achievements of children, rather than income differences.

However, others argue that what Mayer calls a spurious correlation would in fact be an indirect or unobserved variable effect. Duncan, Huston and Weisner [26], for example, suggest that financial support may improve the academic performance of children in poor families. In a random assignment study, they evaluated the impact of the New Hope program, which provided poor families with a wage supplement, subsidized health insurance, subsidized child care, and community service while seeking employment for parents. The results suggest that, on average, the children in the program scored higher than the control group.

These findings indicate that the correlation between income and academic performance of poor children is significant. In addition, poverty is known to be related to poor nutrition, increased exposure to toxic elements, low birth weight, attention deficit disorders, learning disabilities, lack of health insurance, poor housing and several other problems that impact school performance [27] [28] [29] [30] [31].

Guo [32] indicated that long-term poverty influences both academic ability and performance, but patterns may differ by age. While poverty in early childhood might seem to have the most significant impact, this study showed that poverty experienced in adolescence appears to have a stronger influence on academic performance than poverty experienced earlier in life, a finding relevant to the present research.

Duncan and Brooks-Gunn [33], on the other hand, not only concluded that poverty has its greatest impact during early and middle childhood, they also suggested that parental income is a stronger correlate of children's academic ability and performance than levels of maternal and family education, which is in line with the findings of our research.

III. The National High School Examination

The National High School Examination (ENEM) appears in the context of the major educational reforms implemented from 1995-2002, and its inspiration is clearly the U.S. SAT. The ENEM is developed and administered by the National Institute of Educational Studies and Research Anísio Teixeira (INEP), a federal agency linked to the Ministry of Education (MEC) whose self-declared mission is to subsidize the formulation of educational policies at different levels of government to contribute to the economic and social development of the country.

Created under the direction of then-Minister of Education Paulo Renato de Souza, the initial objective of the test was to serve as an annual evaluation of high school students, in order to assist the government in the development of public policies for the improvement of education. In this sense, it is a public policy aimed at evaluating the results of the educational policy applied to the first cycles of education (fundamental and mid-level). Initially, the test contained only 63 questions, much smaller than the current 180, in addition to an essay. The first edition had only 115,600 participants, out of a total of 157,200 registered students.

In 2001, ENEM reached the mark of 1.6 million subscribers and 1.2 million participants. The test was still composed of 63 questions and one essay. That year, the granting of waivers of the enrollment fee was initiated for public school students, a measure that contributed to broadening student access.

With the creation of the University for All Program (ProUni) in 2004, which began granting scholarships to private institutions of higher education linked to performance on the exam, the definitive popularization of ENEM was achieved, reaching 3 million enrollees and 2.2 million participants in 2005. The benefits of ProUni are distributed based on student performance on the exam and can be comprehensive or partial, depending on the family income. To participate in this program, the student must have completed high school entirely in public schools.

In 2009, the exam was reformulated and became a mechanism for access to public universities. The exam expanded from 63 questions to 180 questions distributed in four test books: Humanities, Natural Sciences, Languages and Mathematics, as well as an essay. With the reformulation, the ENEM was expected to become an alternative to the university entrance examination, allowing higher education institutions to better "see" the profiles of students of basic education [34].

Despite several problems that occurred in the 2009 edition, the exam conquered the mark of 4.6 million enrollees the following year. In that year the federal government created the Unified Selection System (SISU), an online tool that cross-references student data pertinent to vacancies in educational institutions with the students' grades on the ENEM. Thus, with only one application, students could apply to public institutions throughout the country.

Also, in 2009, INEP adopted the Item Response Theory (IRT), an evaluation methodology that goes beyond merely counting the total number of correct answers on the test. Using this method, the item is the basic unit of analysis, and overall performance can be explained by the skill of the student and the characteristics of the questions (items).

The IRT does not allow comparison of the number of correct answers in one area of knowledge with another area, since the number of questions per difficulty level in each test and the other characteristics of these questions affect the result. The theory assumes that a candidate with a certain level of proficiency tends to correctly answer items at difficulty levels below his proficiency and incorrectly answer those at higher difficulty levels. The method is not exempt from criticism [34]; however, it enjoys great international credibility [35][36].

In 2017, the number of students enrolled in the exam reached the mark of 7.6 million, with abstention of approximately 30%, which means an absence of more than two million students. However, it continues as the main mechanism for measuring the performance of high school students and as a tool for access to most public and private universities in the country.

IV. Methodology

The data used in this research are available on the INEP website in the microdata section of the ENEM. All of the high school seniors enrolled in public and private educational institutions who lived within the 12 cities and took the exam in the years 2013 to 2017 were selected. It was decided to exclude students who missed any of the exams, as well as those who were eliminated for any reason and therefore did not score on the exam. This measure ensured that the extraction of averages from educational institutions would not be distorted by circumvention, which could result in lower grades for institutions with more students absent.

The grades are made available to each student individually and include the following competencies: Natural Sciences and their Technologies (CN), Languages, Codes and their Technologies (LC), Mathematics and its Technologies (MT), Humanities and their Technologies (CH) and Essay (RE). The grade of the objective tests was the result of the simple mean of the first four competencies, while the final grade was obtained by calculating the average among all the competencies.

Descriptive statistics were used as a method of analysis, focusing on the description of data presented in the form of graphs and tables. This method allows the reduction and summary of data, leading to the smallest possible loss of information [37]. Content analysis used the qualitative methodology.

Statistical analysis was performed using the Statistical Package for Social Sciences 25 (SPSS) for the Windows operating system. The graphs and tables were constructed using Microsoft Excel 2016 from data generated in SPSS or obtained from consulted sources.

To allow for international comparison, all of the amounts quoted were converted to the average dollar price of each relevant year, calculated on the website of the Central Bank of Brazil.

The socioeconomic status of the students was determined based on three variables: father's schooling or education; mother's schooling or education; and family income. These variables are used internationally in similar studies on the relationship between social status and academic performance [18] [38] [8] [39].

To measure the correlation between socioeconomic status and the final grade, we used the Kendall's Tau, a measure of non-parametric correlation that, although not as popular as the Spearman's statistic, is pointed out by many statisticians as the best estimate of correlation in a population [40] [41]. Although correlation is an extremely useful tool, it does not tell us anything about the predictive power of variables. Because of this, the research used multiple regression analysis, in which the final grade was chosen as the dependent variable, while the father's and mother's schooling and family income were chosen as independent variables.

V. Results

As previously stated, the research covered the results of the National High School Examination for the years 2013 to 2017. Only students who were high school seniors in those years had their results compiled, excluding absentees, as well as those eliminated for any reason. The number of students whose ENEM results were the subject of analysis reached just over 30,000, according to the table below:

Table 1. High school students who completed the ENEM per year and institution type.

	YEAR				
Institution	2013	2014	2015	2016	2017
Public	4244	4606	4832	4388	4380
Private	1738	1705	1671	1529	1500
Total	5982	6311	6503	5917	5880

Source: Own elaboration (2018).

It is observed that the number of high school graduates each year does not vary widely, hovering around 6,000 students, which makes the comparison more regular and avoids significant fluctuations that could influence the results.

The number of graduating students in the public school system constitutes approximately 74% of the total number of students, a number that is very similar to the Brazilian national average of 75% in the National Household Sample Survey - PNAD 2015.

Regarding the income profile, the ENEM social questionnaire asks students to frame their family income

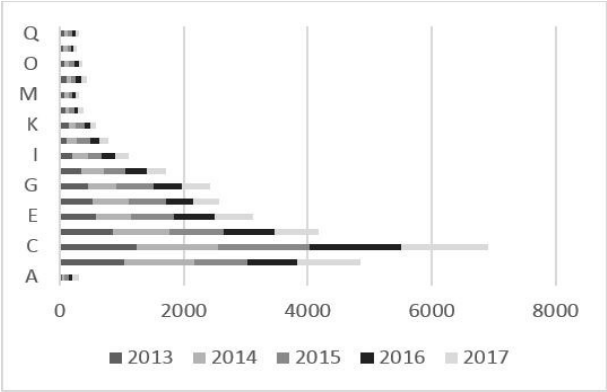
(the sum of the values perceived by all family members) in one of the 17 bands described below:

Table 2. Income bands of the ENEM.

BAND	INCOME
A	No income
B	Up to 1 minimum wage
C	More than 1 and up to 1
D	More than 1,5 and up to 2
E	More than 2 and up to 2.5
F	More than 2.5 and up to 3
G	More than 3 and up to 4
H	More than 4 and up to 5
I	More than 5 and up to 6
J	More than 6 and up to 7
K	More than 7 and up to 8
L	More than 8 and up to 9
M	More than 9 and up to 10
N	More than 10 and up to 12
O	More than 12 and up to 15
P	More than 15 and up to 20
Q	Above 20 minimum wages

Source: Own elaboration (2018).

It should be noted that the values refer to the Brazilian minimum wage, an extremely timely measure, since it allows annual comparisons without the immediate need to use inflation indexes. The distribution of students by income range is described in the chart below.



Graph 1. High school students who completed the ENEM per year and income bracket.
Source: Own elaboration (2018).

The graph shows that the present incomes of more than 50% of the students' were up to two times the minimum wage (corresponding to approximately US $556.00). Considering that the Brazilian average household income in 2017, as determined by the continuous PNAD, was R $1,268 (approximately US $397.00 or slightly more than 1.3 times the minimum wage), it is evident that the region studied occupies a socioeconomic position above the national average, a fact that was already adequately addressed in the introduction when presenting the gross domestic product of the region.

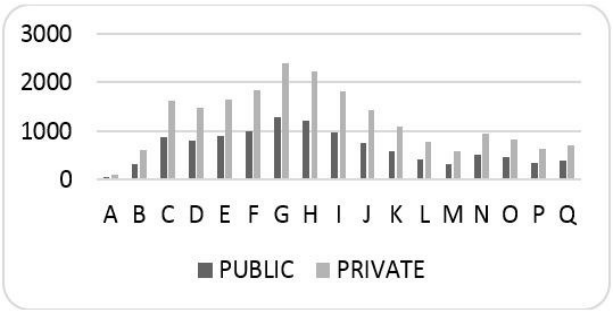
When the averages of the students' final grades are observed, the performance disparity begins to change dramatically, as shown in the table below:

Table 3. Final average scores per year and institutional type for senior-year students of high schools that administered the ENEM.

Institution/Year	2013	2014	2015	2016	2017
Public	511,9	504,7	499,6	508,9	498,3
Private	592,6	599,3	586,1	604,1	609,3
Media	535,3	530,2	521,8	533,5	526,6

Source: Own elaboration (2018).

Grades of students at private institutions are on average 18% higher than those of students at public institutions. Although the nature of the educational institution does not maintain a consistent relationship with parental income, it can be stated without reservation that there is a strong correlation between a higher income and a student's enrollment in the private school system. Just check the chart below, which correlates income and educational institutio--ns, drawn from the number of students who took the exam in the last five years.



Graph 2. Income range of students who took the ENEM in the last five years by educational institution.
Source: Own elaboration (2018).

The graph indicates that the higher the income, the greater the chance that the student will be enrolled in a private educational institution. In each of the income bands included in the ENEM social questionnaire, students with the highest family incomes are in private schools. However, the fact that there are high-income students in the public school system needs to be properly contextualized. Unlike Brazilian higher education, in which a serious imbalance persists, with people from high-income families attending public universities [42], the lower and middle public schools predominately have poor students. According to the survey “Synthesis of Social Indicators: an analysis of the living conditions of the Brazilian population,” prepared by IBGE, based on data from the Brazilian Institute of Geography and Statistics (IBGE, 2012), in public elementary schools, for example, approximately 66% of students have family incomes within the lowest two-fifths. This inequality is even more pronounced in high schools; among students who attended public high schools, only 8.6% came from the richest 20% of families.

This is clearly reflected in the students’ academic performance, as we have seen. When the schools of the studied region are ranked in 2017, it is observed that the advantage of students in private institutions is unequivocal

in comparison to students of the public school system, with the 19 highest-ranking schools being private. The first public school in the ranking is only in 20th place. However, that school is the Federal Institute of Education Science and Technology of Rio de Janeiro (Campus Volta Redonda), which is recognized as a center of excellence in education and is not the general model of public education in the country.

In the assessment of the socioeconomic status of the students, the three chosen variables have been consecrated by other academic studies: schooling of the father and the mother, as well as the family income. The correlation coefficients of these variables can be observed in the table below with the students' final grades, year by year.

Table 4. Correlation and linear regression between the socioeconomic factors and the means of the students' final grades per year.

KENDALL'S TAU

YEAR	Father's Educ.	Mother's Educ.	Income	SIG.	R^2
2013	0,144	0,195	0,254	0	0,15
2014	0,173	0,212	0,266	0	0,16
2015	0,138	0,186	0,254	0	0,16
2016	0,155	0,200	0,254	0	0,17
2017	0,158	0,202	0,262	0	0,15

Source: Own elaboration (2018).

It is known that in social sciences, any value lower than 0.05 is significant [41]. As the research opted for Kendall's Tau in the measurement of the degree of correlation, a statistical measure that normally presents coefficients considerably inferior to the Pearson's Correlation, one can affirm that the variables present average correlation with the grades. It is also observed that family income is the variable that most closely correlates with the final grade, followed by maternal schooling.

However, the correlation only indicates that the variables are related, but says nothing about the causality between them. To evaluate the impact of socioeconomic variables on the final grade, multiple linear regression was used. The table above shows the R^2 values, which indicate that on average 16% of the students' final grades is derived from the students' socioeconomic status, a considerable percentage, since it corresponds to almost the entire difference between the public and private school grades (18%).

In addition, R^2 values are very similar to international studies that evaluated the impact of socioeconomic factors on academic performance. For students who took the SAT, R^2 reached 0.133 [8]. In the case of students at American colleges, the R^2 was 0.145 for general students, but it reached 0.167 for high-income students [43].

Therefore, it is inferred that the impact of income itself on academic performance, and especially on performance on aptitude tests such as the National High School Examination and the U.S. SAT, is a general phenomenon, given the size of the populations researched and the similarity in the results.

VI. Conclusion

Statistical evidence suggests that socioeconomic factors, mainly income, have a direct impact on the performance of high school students who have taken the ENEM in the last five years in the micro-region of the Middle Vale of the Paraíba river.

In addition, evidence that the influence of socioeconomic factors on student test performance is very similar to research results in the United States seems to indicate that the dilemma to be addressed goes beyond the mere question of a region's economic development.

This poses an additional challenge to policymakers, since mitigating income inequality is an extremely complex task. Public policy literature points out that redistributive policies tend to increase social conflict, because it is usually evident which sector will bear the cost and which sector will be the beneficiary of the policy.

However, two variables that make up socioeconomic status do not depend directly on major economic upheavals: the schooling of the father and the mother. The data compiled in this research indicate that maternal schooling is the variable with the second-strongest correlation with student performance on the ENEM. In fact, increasing maternal schooling not only serves the purpose of improving student performance, but also contributes to female empowerment.

Thus, while directly combating income inequality is an often-torturous task for public policymakers, increasing female schooling can yield long-term benefits in a way that causes less social conflict.

The author hopes that this work will be able to serve other researchers who wish to embark on the evaluation of public policies with statistical methods, since the confrontation of public problems demands a precise diagnosis that only the scientific method can provide.

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