

Student Performance Differences In Enem: An Evaluation Of The School's Integral Program Of The Public Network Of The State Of Pernambuco - Brazil In The Period From 2009 To 2016

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Abstract:

Background: In light of Brazil's fiscal constraints and limitations on public investment, it is crucial to evaluate the effectiveness of education policies to ensure the efficient allocation of resources. This study focuses on evaluating the impact of the full-time school policy implemented in the state of Pernambuco on student performance in the National High School Exam (ENEM) between 2009 and 2016.

Materials and Methods: We employed Propensity Score Matching (PSM) to address selection bias, allowing for a comparative analysis between full-time school students and their peers in traditional schools.

Results: Our findings indicate that students attending full-time schools consistently achieve higher scores in all four ENEM knowledge areas from 2013 onwards. These performance improvements are closely associated with the growing acceptance of ENEM scores as a criterion for university admissions in Brazil, demonstrating the temporal requirements for policy effects to take root.

Conclusion: The analysis suggests that full-time education significantly improves students' cognitive abilities, in line with the general improvements in performance observed in public high schools in Pernambuco during the study period. This evidence argues for sustained investment in full-time education programs as a viable strategy for advancing educational outcomes in a fiscally constrained environment.

Key Word: Full-time education ; School performance ; Educational policies ; PSM ; ENEM.

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I. Introduction

Recent research on educational quality and economic growth, such as Woessmann's (2014) paper, provides strong evidence that education is one of the main determinants of economic growth, employment, and gains in modern knowledge-based economies.

If learning outcomes are critical to success, then understanding how those outcomes are affected is key to effective policymaking. One of the main sources of differential learning outcomes is the type of schooling and the relative performance of students enrolled in different types of schools. This has been the subject of considerable debate in developed and developing countries.

It was in this sense that in 2008 the state government of Pernambuco made integral education a policy for high school, and since then, its project is based on the idea that investing in more hours (45 hours a week), as well as the quality of education, is indispensable for the training of young people who are better able to continue their academic life and who are better qualified for the labor market (SEE, 2016a).

The literature on the impact of full-time schooling in developing countries indicates consistent gains in academic performance and cognitive skills, especially when extended school day policies are implemented in vulnerable regions. International studies, such as Woessmann (2016), show that increased school time contributes significantly to academic results, particularly in emerging economies where educational quality can vary widely. In Brazil, research by Marcelino, Justo and Alencar (2017) and Xerxenevsky (2012) supports this evidence, highlighting that extended school time tends to benefit students from lower socioeconomic backgrounds, thus reducing inequality in access to higher education. By analyzing the case of Pernambuco, this study contributes to the debate by evaluating one of the country's most comprehensive educational policies, focusing on its long-term effects on performance in the ENEM exam - a metric widely recognized in the literature as indicative of educational quality (Hanushek and Woessmann, 2011).

The aim of this study is to evaluate the impact of Pernambuco's full-time school policy on student performance in the National High School Exam (ENEM) between 2009 and 2016. Pernambuco was selected as the focal state due to its high number of full-time schools and consistently strong student performance in national assessments.

This study addresses a central question: can full-time schooling serve as an effective policy tool to improve educational quality and high school performance in Pernambuco? The contribution of this article lies in its extended temporal scope (2009-2016) using ENEM microdata and in the rigorous application of appropriate methods for evaluating the impact of public policies.

After this introduction, Section 2 presents the methodology, Section 3 discusses the main results and the final section offers the conclusions.

II. Models For Evaluating The Impact Of Programs Or Educational Policies

To estimate the effects of educational policies, peer control methods are widely used, with Propensity Score Matching (PSM) standing out as an alternative to mitigate selection bias. PSM, initially proposed by Rosenbaum and Rubin (1983), makes it possible to create a control group that is statistically similar to the program participants, maximizing comparability between groups. Empirical studies, such as Becker and Ichino (2002) and Khandker, Koolwal and Samad (2009), have validated the effectiveness of the PSM in impact evaluations, especially in educational contexts where there are observable differences between groups. In this study, the PSM was applied to evaluate the impact of full-time schools in Pernambuco, allowing for a robust inference about the effects of the policy on ENEM performance, based on observable student characteristics.

Procedure methodology

As in the works of Xerxenevsky (2012) and Marcelino, Justo, Alencar (2017) was used propensity score matching (PSM). The method (PSM) initially described by Rosenbaum and Rubin (1983), appears as an alternative to softening the selection bias problem in that it is used to construct a statistical comparison group (control group) composed of schools with students with characteristics like the group of students from schools treated (who participated in the program), but who did not participate in the program. According to Rosenbaum and Rubin (1983), the adjustment in the differences between the groups is made from a large set of variables that would determine the conditional probability of receiving the treatment.

In this study, the PSM method was used to evaluate the impact of full-time high school students in Pernambuco during the analysis period from 2009 to 2016.

Thus, the mean effect of the treatment of the program is calculated as the difference in the mean of the results between these two groups. The treatment effect on the treated (ATT), based on the selection of observable characteristics, can be written as follows:

$$E(Y_i | Y_{0i} | X, D=1) \tag{1}$$

However, the validity of the model will depend on the elimination of this bias. In addition, it is possible to estimate the mean treatment effect on treated (ATT), as follows:

$$E_{p(x)} \{E[Y_1 | p(x), D=1] - [Y_0 | p(x), D=0] | D=1\} \\ = \{E[Y_1 - Y_0 | p(x), D=1]\} \tag{2}$$

The use of $p(x)$ instead of (X) , described by Rosenbaum and Rubin (1983), is known in the literature as a method of propensity score. In short, this methodology allows the matching between participants and non-participants, and from it, the generation of reliable estimates of the average treatment effect.

In this way, the bias problem $E[Y_1 | p(x), D=1] - [Y_0 | p(x), D=0]$ can be reduced to the maximum because in the matching analysis, the comparison structure for the calculation of the average impact of participating or not in the treated group considers the observations with the closest characteristics of the analyzed sample.

A Probit model was used to estimate the PSM. The dependent variable is a binary indicator, where 1 represents a student enrolled in a full-time school and 0 indicates a student in a traditional public school. The explanatory variables in the model, adapted from Pereira, Justo and Lima (2015), are included in a vector of characteristics covering:

- (i) personal characteristics of the student, such as age, gender, race and marital status;
- (ii) educational background, including whether the student attended elementary school in a public or private institution, time taken to complete schooling and whether they studied in urban or rural areas;
- (iii) family background, considering the parents' level of education and family income; and
- (iv) labor market factors, including whether the student only studies or combines study and work, and the parents' occupations.

Data source

The data applied were the ENEM microdata for the years 2009 to 2016. This last one is the most recent year with data availability, not yet explored in other years, allowing the impacts of the comprehensive school implementation program to be implementation time.

The National High School Examination (ENEM) is a survey of educational statistical data carried out annually and coordinated by the National Institute of Studies and Educational Research Anísio Teixeira - INEP / MEC. This is the main instrument for collecting information from Brazilian high school education, which covers different stages and modalities and includes data on teaching, classes, students, classroom teachers, school performance, and students' socioeconomic questionnaires. Each school receives a unique identification number, which is repeated on other bases of INEP data, making it possible to identify and relate their information.

The students' grades in the tests of Human Sciences and their Technologies (CH), Natural Sciences and their Technologies (CN), Languages, Codes, and their Technologies and Writing (CL) and Mathematics and its Technologies (MaTec) were used. Statistical analysis of the data was done using the STATA program in version 15.1.

III. Result

In this section, the results of the PSM will be presented for the four notes of the ENEM participants in Pernambuco, showing the evolution over the analyzed period.

PSM results

The mean annual number of observations was 12378 students in the treated group and 19879 in the control group.

Tables 1, 2, 3, and 4 in detail present the value of Treatment Effect on Treaties (ATT'S) for the year 2016. It prioritized showing results for this year by having the most recent data available and student performance increasing throughout the series, as will be seen below. The values represent the average effect of education policy on full-time on the performance of students in each field of knowledge based on the probability of whether or not students benefit from the policy without the pairing and considering the method of nearest neighbor (neighbor more next). In other words, compared to the control group of the other students from public schools and the State of Pernambuco.

As can be seen in table 1, the results are presented for the Nature Science and Technology (NC) test, Unpaired ATT presented an average difference of approximately (-19.36) points in the performance value between the treatment group (full-time schools) and the control group (traditional time schools). The pairing method of the nearest neighbor, the treatment effect on the treaty (ATT'S) indicated a favorable outcome for the group of full-time schools, with a mean difference of approximately (6.83) points from the group of traditional time schools¹.

Table 1 - Effect of the Treatment Group on the Science of Nature and its Technology (CN)

Method	Treated	Control	Difference	Default error	Statistics t
Unparalleled	469.77	489.14	-19.36	0.63	-30.58
<i>Nearest Neighbor</i>	469.77	462.93	6.83	1.17	5.84

Source: Authors based on microdata ENEM (2016).

Table 2 shows the numbers for the Human Sciences test and its technologies (CH). Unpaired ATT showed an average difference of approximately (17.5) points in the value of performance between the treatment group (full-time schools) and the control group (traditional-time schools). By the nearest neighbor pairing method, ATT indicated a better result for the group of full-time schools, with a mean difference of approximately (5.3) points in relation to the group of traditional-time schools.

Table 2 - Effect of Treatment Group on the test of Human Sciences and their Technologies (CH).

Method	Treated	Control	Difference	Default error	Statistics t
Unparalleled	520.38	537.91	-17.52	0.64	-27.00
<i>Nearest Neighbor</i>	520.38	515.04	5.34	1.28	4,15

Source: Authors based on microdata ENEM (2016).

¹ They were estimated by several methods: closer neighbors with and without pairing; caliper matching; radius matching; kernel matching; and bootstrap. In all cases, the results were favorable to full-time schools from 2013 onwards, with a significant ATT of at least 5%. Results are presented using the nearest neighbors without replacement. This was the case that presented the best balance and lowest variance, following Frölich (2005) and Jann (2017).

The numbers for the proof of languages, codes and their technologies (LC) are presented in table 3. It can be seen that Unpaired ATT also presented an average difference of approximately (14.3) points in the value of performance between the treatment group (full-time schools) and the control group (traditional time schools). By the nearest neighbor pairing method, ATT indicated a better result for the group of full-time schools, with a mean difference of approximately (3.1) points in relation to the group of traditional time schools.

Table 3 - Effect of the Treatment Group on the test of Languages, Codes and their technologies (LC).

Method	Treated	Control	Difference	Default error	Statistics t
Unparalleled	509.35	523.73	-14.37	0.58	-24.37
<i>Nearest Neighbor</i>	509.35	506.28	3.07	1.17	2.61

Source: Authors based on microdata ENEM (2016).

Table 4 shows the numbers for the math test and its technologies (MaTec). Similarly to the other results, unpaired ATT presented an average difference of approximately (33.3) points in the value of performance between the treatment group (full-time schools) and the control group (traditional time schools). By the nearest neighbor pairing method, ATT also indicated a better result for the group of full-time schools, with a mean difference of approximately (4.6) points compared to the group of traditional-time schools.

Table 4 - Effect of the Treatment Group on the mathematics test and its Technologies (MaTec).

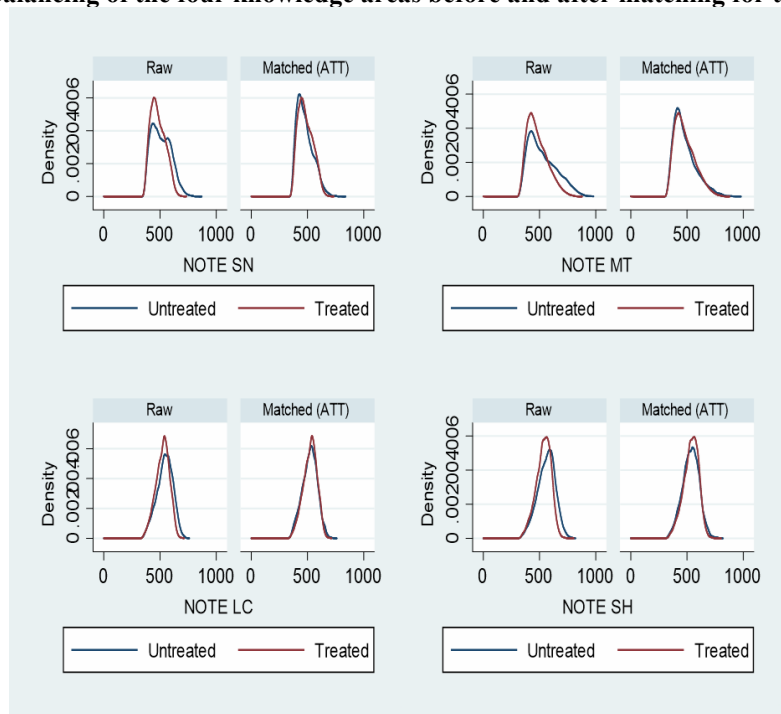
Method	Treated	Control	Difference	Default error	Statistics t
Unparalleled	466.55	499.80	-33.25	0.90	-36.78
<i>Nearest Neighbor</i>	466.55	461.93	4.62	1.65	2.80

Source: Authors based on microdata ENEM (2016).

In view of the above results, the need for the method to analyze the effectiveness of the policy more clearly is evident, since there is a difference in the results without and with the pairing. This indicates that the effect of the observable characteristics interferes with the students' results. That is, without the matching does not control the impact of these characteristics, and the policy does not present the expected result. However, after the control, the results are favorable for the policy in all the evaluated tests. That is, there is a significant distortion in the result, indicating the need to use the method for a more correct evaluation of the policy. All differences found in the mean effect of treatment with paired data are significant at 1%. These results are very relevant for students who wish to enter the most competitive courses of Brazilian universities.

Figure 1 shows the post-match matching between treaty and control for the year 2016 in the four knowledge areas evaluated. It is observed that the results are satisfactory.

Figure 1- Balancing of the four knowledge areas before and after matching for the year 2016



Source: Elaboration of the authors based on the ENEM of 2016.

Finally, Table 5 shows the average results of student test scores in the four areas of knowledge evaluated in the period analyzed from 2009 to 2016. It is observed that the impact of full-time school begins to be favorable from 2013 and increasingly. This indicates that there is a lag in order to perceive an increase in the performance of the students of the full-time schools in the ENEM tests. This result is intuitively expected given that the high school has a three-year cycle. And that the acceptance of the ENEM note as a single requirement for admission to public universities in the country has been growing over the years with the creation of the Unified Selection System (SISU). As well as private colleges. Hence, the schools started to plan the content of the disciplines and internal assessment systems, preparing for the ENEM tests.

In general, these results are corroborated by international studies such as Lee and Barro (2001), Glewwe, Kremer (2006), Hanushek, Woessmann (2011) and Oreopoulos, Petronijevic (2013) and national studies, such as Marcelino, Justo, Alencar (2017).

Table 5 - Effect of Treatment Group on CN, CH, CL and MaTec in the period from 2009 to 2016.

Year	Science and Technology (CN)		Human Sciences and their Technologies (CH)		Languages, Codes and their Technologies and Writing (CL)		Mathematics and its Technologies(MaTec)	
	Treated	Control	Treated	Control	Treated	Control	Treated	Control
2009	458.72*	501.35	462.43 *	505.87	467.42 *	511.37	468.43 *	510.18
2010	470.35*	512.80	521.47 *	566.07	496.94 *	535.94	481.67 *	542.37
2011	431.05*	462.67	440.10 *	469.78	492.13 *	519.06	473.36 *	517.82
2012	459.11*	488.63	507.64 *	536.26	478.97 *	505.20	488.52 *	533.25
2013	448.94*	443.37	490.98 *	483.70	468.98 *	460.43	488.90 *	477.24
2014	454.36*	451.33	513.59 *	509.28	477.92 *	473.31	434.20 *	434.75
2015	458.89*	453.40	539.73 *	533.01	485.47 *	479.35	451.58 *	442.48
2016	469.78*	462.54	520.39 *	515.04	509.36 *	506.28	466.55 *	461.93

Source: Own elaboration based on the ENEM microdata from 2009 to 2016.

Note: * difference between treated and control after significant matching at 1%.

IV. Conclusion

The increasing scarcity of resources requires governments to make public expenditures more efficient. Thus, it is essential to evaluate whether public policies are meeting their objectives.

In this sense, the Brazilian government has pointed to the expansion of full-time school supply as a priority in the ministry of education due to the results presented by some states, such as Pernambuco. Thus, this work aimed to identify the impact of the policy of full-time education adopted by the State of Pernambuco in increasing the cognitive ability of students in the ENEM in the period from 2009 to 2016.

Based on the results presented, we can conclude that the implementation of the full-time education policy in the state of Pernambuco has had a significant positive impact on student performance in the National High School Exam (ENEM). Students from full-time schools consistently outperformed their peers in all ENEM knowledge areas from 2013 onwards, demonstrating substantial improvements in their cognitive abilities. These reinforce the importance of continued investment in full-time education initiatives as an effective strategy for improving educational outcomes during fiscal challenges.

This work has advanced in literature by making an analysis in a larger temporal cut in comparison with other works. This allowed, for example, to identify that the positive results with favorable results to the students of the integral-public schools compared to the students of the traditional-public schools began to appear in significant form after five years of implantation of the policy in the state. It is noteworthy that the results in favor of the policy occurred after the application of the treatability between the treaties and the control group formed by the students at the other public schools of the state with use of the PSM. However, it is necessary to show that the State of Pernambuco has presented performance in the evaluation indicators above the national average for high school. Still, full-time students have achieved better results, which strengthens the success of the policy in raising the quality of high school in the state and favoring public school students to have access to the best courses of the best universities.

The contribution of this work, besides exploring the microdata of the ENEM, still little explored in the evaluation of schools in the integral regime of Pernambuco, was to highlight the impacts of this policy on the students' cognitive ability in the state, that is, it has brought evidence that politics has in fact contributed to raising the quality of high school in state public schools.

Although the use of Propensity Score Matching (PSM) reduces selection bias by creating comparable groups, the methodology does not completely eliminate the possibility of bias due to unobservable variables that can simultaneously influence school choice and academic performance. In observational studies, as highlighted by Heckman, LaLonde and Smith (1999), these limitations are especially relevant. In addition, the choice of variables to estimate the propensity score and the sensitivity to the comparison methods used, such as those

analyzed by Frölich (2005), represent important methodological challenges to guarantee the robustness of the results.

For future work, it is recommended to evaluate the impact of the training of students in full-time schools in the labor market.

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