Impacts of a full-time school program on learning, school's composition and infrastructure: The case of public schools in the state of São Paulo - Brazil

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Abstract

This article assesses the impact of the Programa de Educação Integral (PEI) implemented in the state of São Paulo (Brazil) on test scores and school characteristics. Using difference-in--differences and leads and lags methods, we found positive and significant effects of the program on performance in Mathematics (0.469 standard deviations) and Portuguese (0.462 standard deviations) for ninth grade students. The impact is greater if the school receives the program for a longer time. Also, the program reduced the disparities of scores within schools. We also identified that participant schools undergo changes in their infrastructure and students' socioeconomic profile.

Keywords

Education, Full-time school, Causal impact assessment

Resumo

O artigo avalia o impacto do Programa de Educação Integral (PEI) implementado no Estado de São Paulo (Brasil) sobre o desempenho educacional (SAEB) e características das escolas participantes. Usando diferenças em diferenças e lead and lags, encontramos efeitos positivos e significativos sobre o desempenho em matemática (0.469 desvio-padrão) e português (0.462 desvio-padrão) para os estudantes do 9º ano do ensino fundamental. O impacto é maior se a escola recebe o programa há mais tempo. O programa também reduziu a desigualdade de notas dentro das escolas. Também identificamos que as escolas participantes apresentaram mudanças em sua infraestrutura e perfil socioeconômico dos alunos.

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I21, I26, I28.

1. Introduction

Brazil has undergone a major expansion of education in recent decades, but the quality of the educational system still remains a problem. To improve student learning, several efforts are being made, including lengthening the school day. Data from 2018 shows that Brazil has a school day shorter than the average of the OECD countries and shorter than other Latin American countries and the United States.[1] The Brazilian National Education Plan foresees that, by 2024, 50% of public schools should be full-time,[2] which covers at least 25% of students in basic education (Brasil, s.d).

Aligned with the national guideline, the São Paulo state government established two full-time education programs: the Escola de Ensino Integral (hereafter ETI) and the Programa de Ensino Integral (hereafter PEI). ETI was created in 2005, before PEI, and contemplates the final years of elementary school with the extension of the school day (Governo do Estado de São Paulo, 2005). However, PEI is more comprehensive than ETI, and includes changes in the teachers' hiring process, pedagogical changes, legislative changes, among others (Governo do Estado de São Paulo/SEE, 2018). The program was implemented in 2012 in high school classes, and in 2013 in the upper elementary school.[3] By April 2018, 308 schools were enrolled in the program. This corresponds to approximately 5% of all São Paulo's state schools, and reaches a total of 104,000 students. ETI and PEI increased the school-day length (compared to the regular schools) approximately 29% and 57%, respectively.[4]

[1] According to PISA data (2018), the learning time per week in Brazil was 25.7 hours. The OECD average was 27.5; Chile, Peru, Mexico and the United States were 31.1, 30.4, 28.4 and 30.4, respectively.
[2] A standard school in Brazil is part-time, where the length of a school-day ranges from 4 to 5 hours (INEP, 2020). A full-time school is usually defined as such when the school-day is equal to or more than 7 hours per day.
[3] The upper elementary school corresponds with the sixth to ninth grade.
[4] The average number of hours per week in upper elementary school in São Paulo state schools was 27.5 (School Census, 2017). ETI and PEI schools have on average, respectively, 35.4 hours and 43.3 hours per week (Governo do Estado de São Paulo/TCE, 2016).

It is not straightforward to assume that longer school hours imply gains in academic performance. For example, the federal program Mais Educação, created in 2007 with the intention of expanding full-time education seems to have been unsuccessful in increasing student performance (Xerxenevsky, 2012; Aquino et al., 2015; Almeida et al., 2016; de Oliveira et al., 2016). Beyond the impact on academic performance, there is even more uncertainty about other impacts of full-time school, such as changes in schools' composition. For example, Rosa (2019) finds that students from private middle schools in the Brazilian state of Pernambuco migrate to public high-schools with full-time school programs. These results indicate that full-time schooling can attract students of higher socioeconomic level. Using a different approach than Rosa (2019), we investigated whether the profile of students from schools participating in PEI has changed. We also analyze if the program affected other school features, such as the number of teachers per class, number of laboratories and other variables related to infrastructure.

The aim of this paper is to evaluate the impacts of PEI on student performance, and to analyze whether there are changes in the composition of students and in the infrastructure of the schools that receive the program. These changes may be a mechanism by which the average academic performance of treated schools improves, but are taken into account when estimating the impact of the program. We use differences-in-differences and leads and lags strategies to estimate the impact of PEI on ninth graders students' academic performance. As a robustness analysis of the results, we use the propensity score matching methodology in conjunction with differences-in-differences. We find that PEI has improved the schools' average test score for mathematics and Portuguese. This improvement occurs in the first year that the school receives the program, and is amplified in the following years. The program also reduces the dispersion of scores among students in the school. Moreover, the composition analysis shows that the program also impacted positively the number of students in each class, but negatively the number of classes. Regarding the socioeconomic composition of students, PEI either attracts students with higher socioeconomic profiles, repels students with a lower profile, or both.

This paper contributes to the literature in three aspects. First, it is the evaluation of a program that, until now, does not have published quantitative academic studies to assess its impacts. Second, PEI differs from other full-time schooling programs implemented in Brazil at the time, and there are positive results on school performance. These lead to a reflection on the essential characteristics of a successful full-time education program. Third, it provides evidence that full-time school programs are attracting students with higher socioeconomic profiles.

In addition to this introduction, this paper presents the rationale behind the extended school time in Section 2, followed by a brief literature review in Section 3, presenting empirical results from national and international full-time school programs. We describe the PEI program in section 4, and provide descriptive statistics in Section 5. Section 6 presents the methodology that is used in the impact estimations, which are presented in Section 7. We divided this last section into three parts: the impact on academic performance (Section 7.1), robustness analysis (Section 7.2) and composition analysis (Section 7.3). Finally, Section 8 discusses the results and Section 9 concludes.

2. Rationale behind the extended school time

The educational production function relates the inputs to the maximum possible learning and is based on the production function in the firm theory. Among the various inputs, we have those related to families, peers, and the school, such as teacher quality and available infrastructure (library, room size). Among the school's inputs, we have the time the student stays at school (i.e., the number of hours per school-day, the number of days in the week, or the number of school days in the year). The theoretical foundations that place time as one of the central elements for learning are in the model proposed by Carroll (1963). According to the author, success in learning depends on the amount of time that a person spends learning a given task, given the amount of time needed to learn the task. Formally, the degree to which a task is learned is given by the ratio of the time currently spent learning such a task to the time needed to learn such a task (illustrated by equation 1).

$$Degree\ of\ learning = \frac{Time\ spent\ learning}{Time\ needed\ to\ learn} = \frac{f(time, perseverance)}{g(aptitude, quality\ of\ instruction, ability)} \quad (1)$$

The numerator of this ratio depends on the time allocated for learning (i.e., instruction time). Also, it depends on their level of perseverance, expressly the time engaged in learning. The denominator of the ratio, that is, the time needed for students to learn depends on their aptitude, the quality of instruction they receive and their ability to understand the instruction. Carroll (1963)'s model therefore suggests a positive relationship between instruction time and learning: all other things being equal, the greater the time allocated for learning, the greater should be the degree of learning. Thus, a key task for the policy maker is to set the size of these times for learning.

Although Carroll (1963)'s model indicates a positive relationship between instruction time and learning, Levin and Tsang (1987) shows that the mechanical increase in the school day may be an inefficient policy to improve the academic performance of students. These authors start from Carroll (1963)'s model and establish the learning of a given task as a function of the student's capacity to learn; effort to learn; time devoted to learning; and level of learning resources. Similarly, as in the previous model, all else being equal, the more time devoted to learning, the greater the learning. The point here is that there is a relationship between time devoted to learning and effort - these are the two inputs that depend on the student and that are in the production function of the tasks to be performed, and those tasks that are the arguments of the student's utility function. The theoretical result of the model is that the student will reduce his effort if the additional instructional time is higher than the equilibrium. The reduction in effort is a mechanism to compensate for the involuntary increase in learning hours. If the increase in the number of hours is not large enough, the reduction in effort is enough to cancel out any gain in performance. If the addition of hours is large, the student may have gains in performance, however he may choose to allocate his time and effort in another manner and drop out of school.

However, the additional instruction time may have an effect on student's performance if combined with other changes in learning. Levin and Tsang (1987) argue that an increase in non-pecuniary rewards for students - that is, policies that make schools more attractive, making the learning experience more interesting - may eliminate the student's effort reduction. According to the authors, if students are, because of the attractiveness of the school, more interested in learning, they will devote more time and effort to learning activities. It turns out that the PEI, the program that this paper seeks to evaluate, has interfered with different variables than just learning time. As we will see in more detail in section 4, the program has promoted important pedagogical changes related to student protagonism at school, promoting changes in the learning environment. In this regard, the increase in time instruction in PEI schools was combined with activities that make schools more attractive. We can build on Levin and Tsang (1987) and expect that any decrease in PEI's student effort (occurring in consequence of the instructional time increase) would be eliminated or diminished by the fact that PEI's schools will be more attractive to students. In that sense, we can expect a positive effect of PEI on students' performance.

The program has also changed the teacher's work contract, reinforcing the teacher's bond with the school, with an impact also on the teacher's salary. And greater accountability was also inaugurated, with peer and student evaluation of teachers, with the possibility of sanctions. All these variables enter into the educational production function, with possible impacts on learning, in addition to classroom time and the learning environment. There are papers in the literature that analyze the impact of these other variables on learning. For example, teacher turnover (Ronfeldt et al., 2013); recent evidences about teacher salary impact (Pugatch and Schroeder, 2018; De Ree et al., 2018); and school accountability (Figlio and Loeb, 2011). We will not be able to estimate the individual impact of each of these variables, only the total impact of PEI, but possibly all of the elements listed above may have some contribution to explaining the effect of PEI on learning.

3. Literature Review

3.1. International evidences

Systematic review from early research revealed that much evidence about increasing school-days fails to address causal inference (Cuban, 2008; Patall et al., 2010). However, recent research begins to address causal effects. Lavy (2015), for example, explores the differences in school days across subjects that the same student faces within his or her school, to analyze the relationship between length of day and educational performance. Using PISA data from 2006, Lavy (2015) shows a positive relationship between instructional time and test scores. In line with the Levin and Tsang (1987) theoretical microeconomic model, he finds non-linear impacts of the number of hours (with a larger effect in the range of 1-2 hours than at higher levels), implying diminishing marginal returns of the instructional time. Evidence from PISA 2018 shows that the language instruction time correlates positively with languages score, but up to three hours per week. Beyond that point, the correlation is insignificant, and after five hours per week is negative (Radinger and Boeskens, 2021). However, these results should be interpreted with caution since it is correlational and doesn't rely on a causal identification strategy.

Since experimental designs are rare, many of them rely on quasi-experimental strategies, including differences-in-differences. For example, in Japan, Kikuchi (2014) shows, using a curriculum revision, that decreasing 13% in time instruction changes 0.5 years of schooling, controlling for individual's characteristics, birth cohort and regional effects. In Southern Italy, increasing time spent in school shows positive impacts on math only on schools with lower performance. However, the impact is driven by the larger effects for the best students in those disadvantaged schools (Battistin and Meroni, 2016). In Uruguay, evidences using propensity score matching, also shows an impact of full-time school on learning in disadvantaged schools (Cerdan-Infantes and Vermeersch, 2007).

Evidence from Chile also reinforces the positive impact of full-time schools on learning. Bellei (2009) estimates an average impact between 0.05 and 0.07 standard deviations on language scores and between 0.00 and 0.12 on math scores (Bellei, 2009). The author used a set of covariates school level and student covariates, such as: socioeconomic variables, the number of grades repeated, parents' expectations, socioeconomic status of the school, school's size, type of school administration, and geographical school location. The authors found no changes in including the covariates.

Despite the evidence from the work cited above, student covariates may be a confounder factor in determining the impact of full-time schools, since student characteristics are an input of the educational production function. The Coleman Report was the seminal study that pointed out the importance of student characteristics in determining student outcomes (Coleman, 1968). The study sought to investigate racial segregation in the educational system in the US. The expectation was that the significant difference in educational performance observed between black and white students was due to differences in the quality of schools attended by the different demographic groups. The results, however, frustrated such expectations. The conclusion was that family characteristics of students and their peers were more important in explaining student performance than school characteristics. Although the Coleman Report was criticized for methodological issues, several studies followed and continued to point to the importance of family and peer characteristics in explaining student performance. In that sense, when assessing the impact of the full-time school on learning, controlling for student characteristics is necessary.

Several international studies show the impact of increasing the learning hours in school, however only a few of them explore the mechanisms behind these effects. Agüero et al. (2021) analyze the drivers of the large effect on mathematics scores of a full-time school program in Peru (0.24 standard deviations). They find that the child's time use changes: while spending more time in school, they spend less time on household chores, studying at home, and sleeping. Also, there were school infrastructure changes: an increase in the number of classrooms with computers and laptops, staff, and pedagogical resources. Teachers had an increase in their salaries and had changed pedagogical practices. However, there were no significant changes in their satisfaction or attitudes. The program also positively impacted the students' non-cognitive skills and positive self-perception towards learning competencies. Finally, there was no evidence that the program changed the student's profile or attracted better teachers.

3.2. National evidences

In 2007, the Brazilian national government created the program Mais Educação, which was implemented full-time in several schools. The program consists of lengthening the time students stay in school, providing different activities in this extra time from the standard curriculum. However, several studies conclude that the program has not resulted in a positive effect on the academic performance of participants (Xerxenevsky, 2012; Aquino et al., 2015; Almeida et al., 2016; de Oliveira et al., 2016). Also, the impacts may be negative in enrollment and grade promotion depending on the school grade (Vidigal and Vidigal, 2021).

Programs that not only expand the school-day, but also include pedagogical and school-management innovations may be more successful. For example, Rosa et al. (2022) study a full-time program in Pernambuco, which includes curriculum changes (e.g. "life-project" program), changes in teacher wages, and some school's physical inputs changes. They find significant impacts on math and Portuguese high-school test scores. Moreover, Kawahara (2019) evaluates a full-time school program implemented in public schools in several Brazilian states. This program brings pedagogical and management innovations, such as putting the student at the center of the learning process and creating incentive systems for teachers based on results. The full-time program is evaluated in both high school and elementary school, and in both cases the estimated impact of the program on mathematics and Portuguese language scores is positive.

Taking advantage of the heterogeneity in program implementation, Kawahara (2019) also tests the transmission channels through which the full-time school program appears to have an effect. The results found by the author indicate that, when there was involvement of mediators and political actors, the results of the program were worse, and when there was a selection and removal process of principals and/or teachers, changes in legislation and implementation of curriculum, the results were better.

In addition, Kawahara (2019) has investigated the impact on some students and schools' features. It is found that the full-time schools attracted students with highly educated mothers, and also increased the share of students seeking for colleges in their last year of high school.

The impact of full-time school on schools' composition is also analyzed by Rosa (2019), using a different strategy. The author tracks students and shows that the full-day program in the state of Pernambuco increased the migration of students from private to full-time public schools. This effect was larger when the test scores differences between public and private schools were smaller. These results raise an important concern that full- time school programs can attract students that would have paid for a private education, therefore reducing the total amount of education consumed by society.

There are two different full-time school programs in São Paulo, one is PEI, the object of analysis of this study, and the other one is ETI (Escola de Tempo Integral). Aquino and Kassouf (2011) study the effect of the second program on learning outcomes, using the state assessment Saresp. The program does not affect Mathematics test scores and pass rates and has a small effect on Portuguese outcomes. The authors argue that one limitation that can explain this result is the short-term analysis since ETI started in 2006, and they assess the impact one year after the implementation. ETI has some common characteristics to PEI, such as: lengthening the school day for about 9 hours and providing a diverse curriculum after time: foreign language workshops, computer classes, and artistic and physical education (Cruz et al., 2018). Although ETI and PEI share common features, PEI differentiates itself by the existence of continuous training for school staff, monitoring of teacher performance, and a curriculum matrix common for all schools and with activities in the youth protagonism (Cruz et al., 2018).

We didn't find any impact evaluation regarding specifically the full-time school program in São Paulo (PEI). de Miranda et al. (2017) made a descriptive analysis of the program in three cities, and reported an improvement in the mean scores of the schools in the program after implementations. According to the authors, the increase in the school day is not a necessary and sufficient condition for improving performance. Despite this, it offers subsidies for this improvement by placing the students in different socialization conditions than those in part-time shifts. Furthermore, de Miranda et al. (2017) suggests that the exclusive dedication of teachers, together with improved wages, may be linked to an improvement in the test scores. However, nothing confirms that it was due to the PEI that there was an educational improvement, since the authors do not make an evaluation controlling for factors that can have an influence on academic performance and are not related to the program. This paper aims to evaluate PEI by controlling for these factors, and also evaluate the effects on schools' composition and infrastructure.

4. Institutional Background

The state of São Paulo implemented the Programa de Ensino Integral (PEI) in 2012, using as reference the Ginásio Pernambucano experience. This model, implemented first in one public school in the state of Pernambuco in 2004, served as the standard for the full-time school state program in Pernambuco, and it was the inspiration for the Ginásio Experimental Carioca, in Rio de Janeiro (Cruz et al., 2018; Cortes, 2015). The Ginásio

Pernambucano model is based on student protagonism and a diversified curriculum, as well as innovative school management (Governo do Estado de São Paulo/SEE, sd).

The student protagonism takes shape, for example, in the Life Project, a mandatory subject in elementary and high school. In this subject, young people trace their journey beyond school and their actions to achieve their goals and dreams in life. Teachers guide these actions, but it is the students who put them into practice. This project is materialized in a document that follows the student during his or her school career and is constantly revisited. Other school activities also make the young person an active subject of learning, such as student clubs and class leaders.

In addition to the Life Project, the diversified curriculum is composed of elective courses designed by the school's own teachers, and chosen by the students. These subjects promote interdisciplinary work, and should be a space for experimentation and for diversification. ETI (the other full-time school education program in São Paulo) also features a diversified curriculum. However, it differs from PEI in that these diversified activities are not in consonance with the regular curriculum, being taught exclusively in the afternoon shift. In addition, the diversified part of the ETI is decided by the state secretary, and it is not up to the school to change according to its needs, as in the case of the PEI (Governo do Estado de São Paulo/TCE, 2016).

Besides the differentiated pedagogical methodology, PEI presents significant changes in the teaching career. The teachers follow the exclusive dedication regime, working 40 hours a week, and receiving a bonus of 75% of their base salary for this full dedication. In addition, teachers and managers undergo an internal evaluation by students and other teachers, and their permanence in the school is conditioned based on this evaluation.

The priority for enrollment in these schools is for students who were already enrolled prior to the implementation. Schools join the PEI on a voluntary basis through the school board, and the secretary of education is responsible for evaluating whether the school will receive the program. PEI began in 2012 with 12 high schools, expanded in 2013 to elementary schools, and by 2015, 157 elementary schools were participating in the program.

Although the program's pedagogical methodology is not exclusively focused on students' academic performance, the question is whether the PEI has an impact on student performance in mathematics and Portuguese. This evaluation is important, since it allows comparison with other schools not participating in the program. This paper aims to answer this question, and analyze whether there are changes in the schools' composition and the schools infrastructure.

5. Data and Summary statistics

We considered in our analysis São Paulo state schools in the years 2009, 2011, 2013, and 2015. We measure the students' performance using data from basic education national assessment in Brazil (SAEB), which measures learning in mathematics and Portuguese. All data used is aggregated at the school level. We used the average scores of the schools for the ninth grade (last grade of elementary school) as the main outcome variable. Besides this, we also used other national data available to characterize the schools and their students (School Census and SAEB). Information about the participation of schools in the PEI was made available by the São Paulo Secretary of Education.

Table 1 presents the number of PEI and state schools considered in each of the years of analysis[5]. It also presents the number of schools with at least one 9th grade class lasting more than 7 hours (hereafter regular full-time). These regular full-time schools can be the ones participating in the Mais Educação program, but it is not restricted to it.

Table 1 – Number of Schools Participating in Full-time School Programs and Number of State Schools Considered in the Analysis

	Year:			
	2009	2011	2013	2015
PEI	0	0	22	153
Regular full-time	266	196	180	258
State schools	3678	3638	3622	3531

Source: School Census, SAEB, São Paulo Secretary of Education.

[5] All counts presented in Table 1 are after merging the data from the School Census and SAEB. In this merging some schools are lost due to missing information in the databases. This is expected since the SAEB scores are only made available for schools that achieve a participation rate of at least 80% of students enrolled in the evaluated teaching stage. More specifically, 0.98% of schools participating in the PEI (3 schools) and 0.97% of non-participating schools (124 schools) are lost.

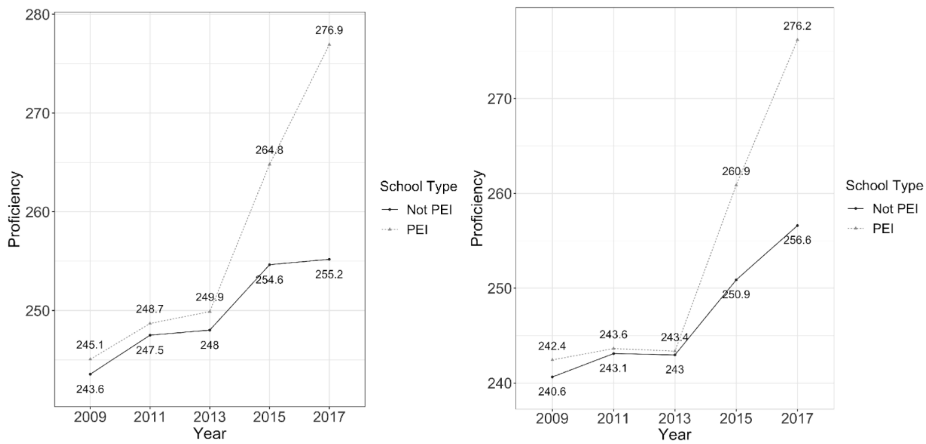
The descriptive statistics are presented in Table 2. All numbers refer to 2009, and treatment and control groups statistics are separated. It is noticeable that schools in the treatment group had fewer students in 2009, with a similar number of teachers and fewer staff. In addition, these schools had, on average, better infrastructure, and received more students with characteristics that are related to higher income, as observed by the significant difference in the mean proportion of mothers with higher education and in the proportion of students with a computer at home. These differences point out the importance of controlling for observable characteristics when estimating the impact of the PEI.

The proportion of schools in 2009 that already had full-time education is also significantly higher in the treatment group, which may indicate the program's preference for schools that already had an extended school day, although this is not a rule.

In relation to test scores, graphs (a) and (b) in Figure 1 show that, until 2013, schools receiving the PEI followed the same trajectory as the other state schools, but after 2013 there is a detachment of proficiency between these two groups, both in mathematics and in Portuguese.

Although these graphs provide support for the common trend hypothesis, it was expected that the detachment would start in 2013, the first year of PEI's implementation in elementary school. But as reported in Table 1, in 2013 only 22 schools were receiving the program, while in 2015, 153 schools were in the treatment group. Graphs (a) and (b) in Figure 2 break down PEI participants by program entry year.

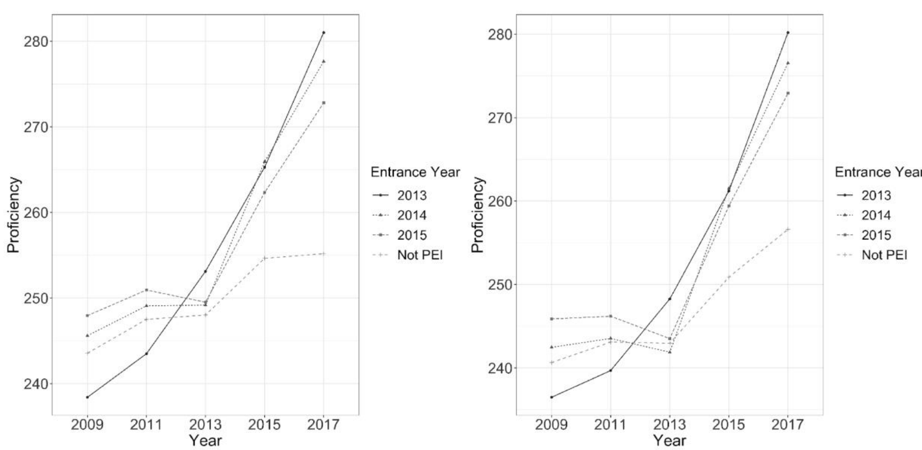
There is evidence that schools follow a common trend through the first year of receiving the program. However, a concern arises about the validity of this hypothesis for Portuguese proficiency, given that there is a reduction in the average score of schools prior to the entry into the program (2014 and 2015). This issue will be formally addressed by the leads and lags model (section 7.1).



(a) Math Proficiency (b) Portuguese Proficiency

Figure 1 – Common Trend - 153 participants (PEI) schools and 4977 non-participants (Not PEI)

Source: SAEB



(a) Math Proficiency (b) Portuguese Proficiency

Figure 2 – Common Trend by year of PEI entrance

Source: SAEB

Table 2 – Descriptive Statistics of Selected Variables - 2009.

	Treatment		Control	
	Mean	Standard Deviation	Mean	Standard Deviation
School census				
No. total students***	364.289	143.679	506.481	256.893
No. teachers	121.793	40.550	126.789	56.657
No. staff***	61.393	20.230	70.015	27.618
No. classes***	11.400	3.995	14.712	6.611
Prop. of men**	0.518	0.034	0.512	0.030
Prop. white***	0.511	0.156	0.557	0.196
Prop. teachers with graduation	0.241	0.241	0.255	0.238
Prop. who use public transport ***	0.098	0.175	0.149	0.223
Has sport court***	0.985	0.121	0.950	0.218
Has computer lab.	0.963	0.190	0.964	0.187
Has science lab.***	0.459	0.500	0.314	0.464
Has library	0.059	0.237	0.058	0.233
Regular full-time***	0.481	0.502	0.057	0.231
SAEB				
Mathematics test score**	244.804	13.883	242.502	14.818
Portuguese test score**	242.162	13.817	239.808	14.867
Prop. mothers with only high school***	0.179	0.074	0.159	0.074
Prop. mothers with higher education*	0.047	0.038	0.041	0.036
Prop. illiterate mothers***	0.022	0.021	0.029	0.025
Prop. at right age*	0.663	0.117	0.643	0.119
Prop. who work ***	0.097	0.047	0.122	0.056
Prop. had late entrance	0.013	0.015	0.013	0.014
Prop. who had only public school	0.653	0.118	0.656	0.112
Prop. had already failed **	0.142	0.060	0.153	0.065
Prop. had already dropout**	0.026	0.020	0.029	0.021
Prop. with Fridge	0.725	0.111	0.714	0.113
Prop. with TV	0.708	0.107	0.693	0.110
Prop. with Computer***	0.480	0.136	0.437	0.145
Prop. with domestic worker*	0.065	0.035	0.059	0.033
Mean No. of bathrooms	1.380	0.142	1.372	0.159

Note: Asterisks indicate Student's t test for the difference between the means of the treatment group and the control group (alternative hypothesis: the difference between the means is different from zero). ***significance at 1% level; **significance at 5% level, *significance at 10% level. Variables beginning with "No." are counts, variables beginning with "Prop." are the proportion of students in the school who possess a given characteristic, and variables beginning with "Has" are the proportion of schools who possess a given characteristic. The variables "Prop. mothers..." refer to the proportion of the mothers or the women responsible for the student, which informs the answers about her characteristics in the SAEB. The variable "Regular full-time" was constructed from the number of hours reported in the School Census for each class. This is a *dummy* for schools that have at least one final year class of elementary school with a school day longer than 7 hours. The School Census variables take into account all classes in the final years of elementary education (grades 6 to 9), while the SAEB variables take into account the ninth grade.

6. Identification strategy

The first objective of this paper is to estimate the impact of PEI on students' performance. To achieve this goal, we used the difference-in-differences identification strategy (Card and Krueger, 1993; Angrist and Pischke, 2008). As the control group, we consider São Paulo's state schools that did not participate in the PEI, and as the treatment group, the state schools with the PEI at the given year.

Let Y_{0it} be the mean test score of school i in year t, if school i does not participate in the PEI in year t. Let Y_{1it} be the mean test score of school i in year t if it participates in the program in period t. Let $X_{it} = [x_{1it}, x_{2it}, \ldots, x_{Kit}]'$ be a set of observed characteristics of school i in period t; and A_i, a set of unobserved characteristics fixed in time of school i. Given X_{it} and A_i, we assume the fact that the school's participation in the PEI at some future point in time informs nothing about its performance prior to participation, that is:

$$E[Y_{0it}|X_{it}, A_i, D_i] = E[Y_{0it}|X_{it}, A_i] \quad (2)$$

where D_i is a dummy that indicates whether the school participates in the PEI in any year.

Controlling for observed variables is important because changes in these variables over time can be confounding. For example, participation in the PEI may have caused changes in the profile of students attending the school and its infrastructure[6]. Since these variables also affect student performance (they are the educational inputs of the educational production function), it is necessary to include them as controls in the estimates of interest.[7]

[6] As already pointed out, Rosa (2019) shows a change in the profile of students for Pernambuco's Integral Education Program. We also find evidence in this direction in the present paper, as shown in section 6.3.

[7] Since Coleman (1968), family characteristics of students and their peers have been highlighted as essential determinants of student performance. For studies that look at school infrastructure variables on educational performance, see, for example, Albernaz et al. (2002) and de Paiva Franco and Menezes Filho(2017), who show school production function estimates for Brazil.

The basis of the differences-in-differences strategy are the assumption that unobservable factors are fixed in time and the common trend assumption, which in this case means assuming that schools have a common time fixed effect. That is:

$$\begin{aligned} E[Y_{0it}|A_i, X_{it}, t] &= \alpha + \gamma A_i + \beta X_{it} + \lambda_t \\ E[Y_{1it}|A_i, X_{it}, t] &= E[Y_{0it}|A_i, X_{it}, t] + \delta \end{aligned} \tag{3}$$

where λ_t is a common time fixed effect across state schools and δ is the average impact of the PEI on Y. Furthermore, it is also assumed that this impact is homogeneous across groups of schools with different entrance years in PEI.[8] The average impact δ will be obtained by estimating the following regression:

$$Y_{it} = \lambda_i + \gamma_t + \delta PEI_{it} + X'_{it}\beta + \epsilon_{it} \tag{4}$$

where ϵ_{it} is a normally distributed random term; λ_i is school fixed effect; γ_t is a time fixed effect; $\beta = [\beta_{x_1}, \beta_{x_2}, \ldots, \beta_{x_K}]'$ is a column vector with coefficients from the regression; and PEI_{it} is a dummy that indicates whether school i is participating in the PEI in year t.

The δ coefficient in equation 4 is interpreted as the average impact of the PEI on the grade of participating schools over the entire period that the program was in place. To better understand the program, we can estimate this impact diluted across years of participation. We use the leads and lags' strategy proposed by Autor (2003) to estimate the average impact of the t-th period of participation in the PEI. For this, we estimate the following regression:

$$Y_{it} = \lambda_i + \gamma_t + \sum_{r=1}^{n} \delta_r D_{it+r} + \sum_{r=0}^{m} \delta_{-r} D_{it-r} + X'_{it}\beta + \epsilon_{it} \tag{5}$$

where r is an integer, D_{it-r} is a dummy indicating that treatment at school i occurred in year t − r. Similarly, D_{it+r} indicates treatment at school i in year t + r. The terms δ_{-r} and δ_r are coefficients to be estimated. The rest of the notation follows what was previously defined.

Following Autor (2003) notation, we call the dummies D_{it-r} lag r and it is 1 if the school participated in the PEI in the year t − r. Thus, the lags capture the effect of the PEI r years after its implementation. On the other hand, we call the dummies D_{it+r} the lead r. It is 1 if the school receives the PEI in year t + r, capturing the effect from the years before the implementation of the PEI. Thus, the leads serve as a test of causality[9], and its coefficients are expected to be zero. Table 3 shows all leads and lags dummies used in our regression. If the school begins participating in the PEI in the year indicated by the columns PEI_{start}, then in the year t, indicated in the rows of the table, the dummy referring to the junction of the PEI_{start} and row t is equal to 1. Otherwise, it is equal to zero.

Table 3 – Leads and lags dummies' construction

PEI_{start}	2013	2014	2015
2009	*lead 4*	*lead 5*	*lead 6*
2011	*lead 2*	*lead 3*	*lead 4*
2013	*lag 0*	*lead 1*	*lead 2*
2015	*lag 2*	*lag 1*	*lag 0*

We present the estimations of regressions 4 and 5 in Section 7.1, considering as dependent variables the average school proficiency in mathematics and in Portuguese. We estimate each of the regressions with and without the covariates X_{it}. As a robustness analysis of the results, in Section 7.2 we perform a matching before the difference-in-differences estimation, restricting the control and treatment group to schools with similar observable characteristics in 2009. In Section 7.3, we perform the composition analysis by estimating the differences-in-differences regression with school characteristics, student characteristics and the coefficient of variation of test scores as dependent variables.

7. Results

7.1. Impact on test scores

Table 4 presents the main results of the evaluation of the impact of the PEI on mathematics (columns 1 and 2) and Portuguese proficiencies (columns 3 and 4), without and with the use of covariates. The covariates used are related to school infrastructure, students' socioeconomic level, other students' characteristics, and dummies indicating the presence of regular full-time.

[9] Known as Granger's causality test (Angrist and Pischke, 2008).

The estimates indicate that the impact of the PEI is significant at a similar level in both subjects. The inclusion of covariates is important to explain part of the variability in scores, controlling also for heterogeneity in the evolution of observable characteristics across schools. In terms of sample standard deviation[10], the average impacts estimated by regressions that include covariates are 0.469 and 0.462 on average proficiencies in mathematics and Portuguese, respectively. The results also indicate that regular full-time (school day greater than or equal to 7 hours) does not impact test scores.

Table 5 presents the results of the leads and lags model. The results indicate that for both test scores there is an increase in the impact of the PEI over the years. In the year of implementation (lag 0) the program shows a significant impact on both scores, and in the following years these impacts are amplified: the estimates for the second year (lag 1) are double the ones of the first year (lag 0). The third year of the program is only observed for schools that started receiving the PEI in 2013 and has an estimated impact of 0.715 and 0.561 sample standard deviations in mathematics and Portuguese, respectively. Compared with 0.573 and 0.510 estimated for the second year, it indicates that the program marginal returns start decreasing in the third year.

We see that the lead 2 of the model for Portuguese proficiency without covariates is significant, although small (column 3 table 5)[11]. As discussed in 5, in graph (b) of Figure 2, the Portuguese scores of schools that began participating in the PEI in 2014 and 2015 fell in 2013 relative to schools that never participated. Despite this, when controlling for covariates, this difference becomes non-significant. This means that the drop in Portuguese score is correlated to variations in the observed characteristics of the schools.

[10] The sample standard deviation, calculated using the grade of all schools in all years of analysis, for mathematics and Portuguese are 15.09 and 15.11, respectively. In terms of SAEB scale standard deviation (45), the impacts would be 0.157 and 0.155 in mathematics and Portuguese, respectively.

[11] When compared to the impact of lag 0, lag 1, and lag 2, the impact calculated for lead 1 is 1.2, 2.4 and 3.4 times smaller, respectively.

Table 4 – Differences-in-Differences Regression Results

	Dependent variable:			
	mathematics scores		Portuguese scores	
	(1)	(2)	(3)	(4)
PEI	9.136***	7.069***	9.760***	6.979***
	(0.774)	(0.838)	(0.850)	(0.903)
Regular full-time		−0.031		−0.450
		(0.743)		(0.801)
Covariates		X		X
Observations	14.469	14.469	14.469	14.469
R^2	0.013	0.178	0.012	0.207

Note: *p<0.1;**p<0.05;***p<0.01
Note: Standard deviations in parentheses. School-level variables. ***significance at the 1% level, **significance at the 5% level, *significance at the 10% level. All regressions include school fixed effects and time fixed effects.

7.2. Robustness Check

In the previous analysis, we used all state schools that did not receive PEIs as the control group. In this section we will restrict the control group to schools that have similar characteristics to the treatment, using propensity score matching. We calculate the probability of treatment p(x) based on characteristics of the school and the students that are part of the school, prior to treatment, in 2009. For the identification of the treatment effect, we need to ensure (Caliendo and Kopeinig, 2008):

1. *Conditional Independence Assumption:* $Y_0, Y_1 \perp D \mid p(x)$: Given the treatment probability p(x), the potential outcomes of not receiving the program or receiving the program are independent of the treatment assignment.

2. *Common support:* $0 < p(D = 1 \mid X) < 1$: For any set of characteristics X, there must be observations in the treatment group and in the control group.

To choose the covariates that determine p(x), we used the hit or miss technique, accompanied with statistical significance analysis[12]. We started from a parsimonious model, with a single covariate (total number of

[12] Method described by Caliendo and Kopeinig (2008).

students)[13] and estimated the probability of receiving the program using a probit. From this model, we iteratively added covariates, keeping the variables that were statistically significant and that increased the sensitivity of the model. All variables refer to the baseline year (2009). Then, we arrived at the model on table 6.[14]

The higher the total number of students, the lower the probability of being treated. However, the relationship is inverse with respect to the number of classes. This indicates that the institutions that are contemplated by the PEI have fewer students per class. In addition, there are suggestions that the schools in the program have better infrastructure and teacher qualifications: having a sports court increases the probability of treatment, and also having a higher proportion of teachers with a graduation degree. Furthermore, the higher the proportion of students in the school who have already failed at some grade, the lower the chance of being treated.

Table 5 – Leads and lags results

	Dependent variable:			
	mathematics scores		Portuguese scores	
	(1)	(2)	(3)	(4)
Lead 4	- 1.413	0.154	-2.606	- 0.705
	(1.704)	(1.561)	(1.870)	(1.682)
Lead 3	0.579	1.553	- 0.464	0.821
	(1.314)	(1.202)	(1.442)	(1.296)
Lead 2	- 2.069	- 1.106	-3.878***	- 2.707
	(1.701)	(1.558)	(1.867)	(1.680)
Lead 1	- 0.237	1.066	- 2.011	- 0.424
	(1.316)	(1.205)	(1.444)	(1.299)
Lag 0	5.090***	4.326***	4.734**	3.685**
	(1.722)	(1.654)	(1.890)	(1.783)
Lag 1	9.743***	8.651***	9.354***	7.702***
	(1.311)	(1.280)	(1.439)	(1.380)
Lag 2	14.600***	10.786***	13.184***	8.483***
	(2.458)	(2.295)	(2.697)	(2.474)
Regular full-time		0.171		-0.271
		(0.747)		(0.805)
Covariates		X		X
Observations	14.469	14.469	14.469	14.469
R^2	0.015	0.179	0.014	0.208

Note: *p<0.1;**p<0.05;***p<0.01

Note: Standard deviations in parentheses. School-level variables. ***significance at the 1% level, **significance at the 5% level, *significance at the 10% level. All regressions include school fixed effects and time fixed effects.

[13] This covariate was chosen due to the large discrepancy between the groups prior to treatment, described in table 2.

[14] Further estimations were done with other probability of treatment models and there were no significant differences.

Table 6 – Probability of treatment (Probit)

	Dependent variable:
	Treatment
No. total students	-0.005***
	(0.001)
Prop. mothers with higher education	1.653*
	(1.000)
Prop. had already failed	-1.895***
	(0.640)
Has sport court	0.629**
	(0.275)
No. classes	0.151***
	(0.039)
No. teachers with graduation per student	0.805***
	(0.543)
Constant	- 1.884***
	(0.303)
Observations	3.679
Log Likelihood	-537,968
Akaike Inf. Crit.	1.089,94

Note: *p<0.1;**p<0.05;***p<0.01

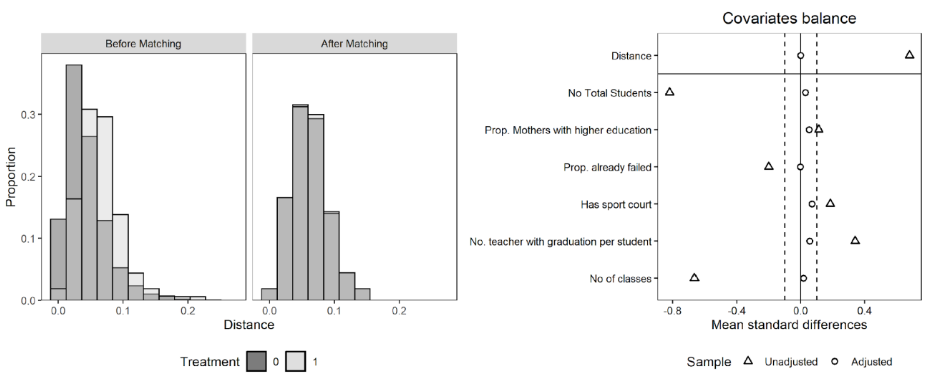
Note: Standard deviations in parentheses. School-level variables. ***significance at the 1% level, **significance at the 5% level, *significance at the 10% level.

The higher the total number of students, the lower the probability of being treated. However, the relationship is inverse with respect to the number of classes. This indicates that the institutions that are contemplated by the PEI have fewer students per class. In addition, there are suggestions that the schools in the program have better infrastructure and teacher qualifications: having a sports court increases the probability of treatment, and also having a higher proportion of teachers with a graduation degree. Furthermore, the higher the proportion of students in the school who have already failed at some grade, the lower the chance of being treated.

The model is able to correctly predict 76% of treated schools (specificity), and 61% of control schools (sensitivity). Part of the difficulty in correctly predicting more schools is due to the imbalance between the number of treated and untreated schools: while 135 schools participated in the PEI, 3543 did not. The complete Hit or Miss statistics are available in Appendix 1.2.

Given p(x) calculated using the probit, we performed a matching with the two nearest neighbors with a maximum distance (caliper) of 0.02 on the propensity score. The matching was done with replacement, and to ensure the common support hypothesis, 1 observation was removed from the treatment group. In figure 3 we verify the common support after matching.

Furthermore, to verify the quality of the matching and also to corroborate the conditional independence hypothesis, a balance analysis of the covariates before and after treatment was performed. The analysis was done in terms of the standardized mean difference.[15] After pairing, all variables do not differ by more than 0.15 in terms of standardized means. The full balance of covariates is available in appendix 1.2.



Common Support (b) Covariate balance

Figure 3 – Common support and covariate balance (Caliper estimation)

For additional robustness, two other pairings were also performed: one using the Radius method with caliper of 0.02 and with replacement; and another using Kernel with a window of 0.02. No observations were discarded in both methods to ensure common support. The common support plots and the covariate balance for these methods are in Appendix 1.3.

The results of the three methods are reported in Table 7 for mathematics and Portuguese, respectively, with and without covariates.

[15] Given that x_1 is a covariate of the treatment group and x_0 of the control group, then the standardized mean difference is: $\frac{\overline{x_1}-\overline{x_0}}{\sqrt{0,5(var_1(X)+var_0(X))}}$

The covariates used are the same as in the differences-in-differences method. When we do the matching, we control for covariates in the baseline, but if there is a change in characteristics between the control and treatment group during the analyzed period, the effect of the program on student proficiency may be "contaminated" by the change in these characteristics. Thus, we estimate controlling also for covariates. In the Radius and Kernel, although no observations were discarded, the number of observations differs from the differences-in-differences because there are observations that did not enter the estimation (had weight equal to zero), and in addition, 17 PEI schools were created after 2009, and therefore did not enter the estimation.

Table 7 – Effect on test scores (propensity score matching)

	Dependent variable:					
	Math scores					
	Caliper		Kernel		Radius	
PEI	9.049***	7.830***	9.274***	7.658***	9.275***	7.697***
	(1.069)	(1.327)	(0.241)	(0.352)	(0.247)	(0.351)
Covariates		X		X		X
Observations	1,440	1,440	14,055	14,055	14,055	14,055
R^2	0.068	0.241	0.013	0.160	0.013	0.160
	Portuguese scores					
	Caliper		Kernel		Radius	
PEI	9.745***	8.406***	9.725***	7.654***	9.727***	7.668***
	(1.130)	(1.374)	(0.260)	(0.367)	(0.260)	(0.367)
Covariates		X		X		X
Obserations	1,440	1,440	14,055	14,055	14,055	14,055
R^2	0.071	0.274	0.012	0.193	0.012	0.193

Note: *p<0.1;**p<0.05;***p<0.01

Note: Standard deviations in parentheses. School-level variables. *** significance at the 1 % level, ** significance at the 5 % level, * significance at the 10 % level. All regressions include school fixed effects and time fixed effects.

The results are similar to those found in subsection 7.1. If we take the Kernel estimations with covariates as a basis and compare it to the previous difference-in-differences estimations, the Kernel ones are 0.589 (3.9% of a standard deviation) and 0.675 (4.5% of a standard deviation) higher for mathematics and Portuguese, respectively. These differences correspond to less than 10% of the estimated impact. Also, both methods' 90% confidence interval for the estimates overlaps for mathematics and Portuguese.

7.3. Composition Analysis

In The previous subsection, we showed that the full-day school program had an impact on test scores, but does it have an impact on the schools' composition or its infrastructure? For instance, has the program attracted students with a higher socioeconomic level? Have the treatment schools hired more teachers per class? In order to address these questions, we estimate, using difference-in-differences, the following model:

$$x_{kit} = \lambda_i + \gamma_t + \delta_{x_k} PEI_{it} + \epsilon_{it} \quad (6)$$

where the variable x_k is a characteristic of the school or its students, i indexes the school, and t the time. For each of these variables, a δ_{x_k} is estimated, which is interpreted as the impact of the PEI on the variable x_k. The intention is to analyze the change in composition that the PEI causes in the schools that receive the program.

The dependent variables are divided into school infrastructure, students' socioeconomic characteristics, other students' characteristics, and coefficient of variation (CV) in grades (standard deviation of school's test scores divided by the mean of school's test scores). For the first three categories of variables, in addition to the results of the differences-in-differences regression, we calculate the sample standard deviation of variable $x_k(\sigma_{x_k})$[16]. The coefficient δ_x is divided by this standard deviation in order to inform about the magnitude of the impact of the PEI on the variable x_k.

Some of the x_k variables were also used as regressors in estimating the impact of the PEI on math and Portuguese grades (table of appendix 1.1). The estimated coefficient for these regressors will be referred to as β_k^{math} and β_k^{port}. When available, the product between these coefficients and δ_x was calculated. If the estimate for β_k^{math} or β_k^{port} is not statistically significant (p-value greater than 0.1), the product is considered zero. These calculations indicate how PEI may have affected grades through an indirect channel, but should be analyzed with caution given that the estimated regressions are not supported by a theoretical model.

Table 8 shows the effect of the PEI on school infrastructure. In order to be eligible to receive the PEI, certain requirements were imposed. One

[16] We calculate the sample standard deviation considering the schools that were not receiving PEIs, and considering only the odd years from 2009 through 2015.

hypothesis is that the school inaugurates better infrastructure to be eligible to participate in the program. The results indicate a significant and positive effect of the PEI on the school having a science lab, with a mean equivalent to 0.789 standard deviations. Although this impact is considerable, the results indicate that having a science lab does not impact scores. Furthermore, the estimated impact of PEI on the number of staff per student is significant and negative, which may be a suggestion of a change in school management. Similarly, this variable does not seem to explain the variability in scores.

Table 8 – Composition Analysis Results - School Infrastructure

School infrastructure

	δ_x	σ_x	δ_x/σ_x	$^{\beta}math$	$^{\delta}x\,^{\times\,\beta}math$	$^{\beta}port$	$^{\delta}x\,^{\times\,\beta}port$	R2
No. classes	-0.366* (0.204)	6.245	-0.059	0.176*** (0.035)	-0.064	0.191*** (0.037)	-0.07	0
No. total students	25.506*** (7.508)	236.912	0.108	-	-	-	-	0.001
No. teachers per class	-0.847*** (0.087)	1.276	-0.664	-	-	-	-	0.009
Has computer lab.	-0.005 (0.013)	0.17	-0.029	-0.213 (0.531)	0	-0.722 (0.573)	0	0
Has science lab.	0.37*** (0.022)	0.469	0.789	0.068 (0.319)	0	0.303 (0.343)	0	0.027
Has library	-0.023 (0.023)	0.256	-0.09	-0.581* (0.304)	0.013	-0.259 (0.328)	0	0
No. staff per student	-0.022*** (0.002)	0.046	-0.478	2.459 (3.144)	0	0.544 (3.389)	0	0.009
Prop. teachers with graduation	0.018* (0.01)	0.185	0.097	0.092 (1.718)	0	-0.963 (1.852)	0	0

Note: Standard deviations in parentheses. School-level variables. ***significance at the 1% level, **significance at the 5% level, *significance at the 10% level.

The number of classes per student is also significantly impacted: while there is a negative impact in the number of classes (−0.059 standard deviations), a positive impact is observed in the number of students (0.108 standard deviations). The absolute number of classes and students dropped, on average, in all schools. Thus the results indicate that schools receiving the PEI had a lesser drop in the number of students, and greater in the number of classes. The lower number of classes is possibly due to the reduction of classes in the afternoon period, as a result of the full school day. These impacts are accompanied by a negative impact in the number of teachers per class (−0.664 standard deviations). This reduction can be explained by the exclusive dedication work-regime imposed by the program. The teachers must work exclusively in one school, probably with a larger workload than before the program.

Table 9 presents the estimates for the impact of the PEI on students' socioeconomic characteristics. In this case, it is not expected that the PEI will change students' conditions by improving or worsening their socioeconomic status. What is tested is whether after the implementation of the program the participating school starts attracting students with a different socioeconomic profile. If there is a change in a short period of time in the treatment schools students' socioeconomic characteristics, it is sensible to assume that this change occurs due to rearrangement on the student's profiles.

The results point out a significant and positive impact of the PEI on the proportion of students with mothers who have completed higher education, on the proportion of mothers who have completed up to high school, and on the proportion of illiterate mothers. In terms of standard deviations, the impact on the proportion of mothers who completed up to high school is considerably larger than the others. The results also point out that mothers with higher education and mothers with up to high school positively impact grades, unlike illiterate mothers. Considering the estimates, attracting students with more educated mothers is associated with an increase in grades, while attracting students with illiterate mothers is associated with a decrease.

Table 9 – Composition Analysis Results - Socioeconomic Characteristics of Students

Students' socioeconomic characteristics

	δ_x	σ_x	δ_x/σ_x	β_{math}	$\delta_x \times \beta_{math}$	β_{port}	$\delta_x \times \beta_{port}$	R2
Prop. illiterate mothers	0.004** (0.002)	0.024	0.167	-26.764*** (4.1)	-0.107	-26.943*** (4.419)	-0.108	0
Prop. mothers with only high school	0.026*** (0.005)	0.077	0.338	14.002*** (1.606)	0.364	17.636*** (1.731)	0.459	0.002
Prop. mothers with higher education	0.011*** (0.004)	0.08	0.137	19.166*** (2.142)	0.211	22.664*** (2.309)	0.249	0.001
Prop. who work	-0.013*** (0.004)	0.055	-0.236	-16.52*** (1.918)	0.215	-30.811*** (2.067)	0.401	0.001
Prop. with domestic worker	0.007** (0.003)	0.039	0.180	-17.054*** (2.259)	-0.119	-25.666*** (2.435)	-0.18	0
Prop. with TV	0.051*** (0.008)	0.102	0.5	0.833 (3.778)	0	8.733** (4.072)	0.445	0.004
Prop. with Computer	0.042*** (0.007)	0.153	0.275	18.897*** (1.54)	0.794	17.148*** (1.66)	0.72	0.003
Mean No. of bathrooms	0.016** (0.008)	0.157	0.102	3.534*** (0.879)	0.057	2.541*** (0.947)	0.041	0
Prop. who use public transport	0.026*** (0.007)	0.231	0.113	-1.5 (1.004)	0	-2.265** (1.082)	-0.059	0.001

Note: Standard deviations in parentheses. School-level variables. *** significance at the 1 % level, ** significance at the 5 % level, * significance at the 10 % level.

The impact of the program on the proportion of working students is significant and negative. This is expected since one of the features of the PEI is the extension of the number of hours a student spends in school, making it more difficult for students to work. In addition, the estimates indicate a positive impact of the program on asset ownership variables, with the largest impact in terms of sample standard deviations being on the proportion who own a TV (0.5 standard deviations).

These results support the hypothesis that the changes implemented by the program attracted students with a different profile to the participating schools. More specifically, the results presented in Table 9 suggest that schools participating in the PEI had, after implementation, a higher percentage of students with a more privileged socioeconomic position. The available data allows us to see the initial and final overall profile of schools students, but does not allow us to see the students' flux. The participant schools might have attracted students with a higher socioeconomic profile, or repelled students with a lower profile. Given that the overall number of students is decreasing in the schools at a faster pace in the control group schools, one hypothesis is that the participating schools are attracting a portion of the control group students that have a higher socioeconomic profile.

Kawahara (2019) has also found that full-time schools had an impact on attracting students with highly educated mothers and with higher family income. Although this result is in line with the results of the present paper, we cannot say that this is exactly what happened - as the number of students in the treated schools increased relative to the number of students in the control group schools, it may be that students with a higher socioeconomic profile from these schools migrated to the schools participating in the PEI. Also, Kawahara (2019) has found that the full-time program impacted negatively the share of students that are looking or had looked for a job. This is partially aligned with our result that PEI had reduced the share of students who work. More boys work than girls in Brazil, but this gap has narrowed over time.[17]

Table 10 – Composition Analysis Results - Other Student Characteristics

	δ_x	σ_x	δ_x/σ_x	$\beta math$	$\delta_x \times \beta math$	$\beta port$	$\delta_x \times \beta port$	$R2$
Prop. of white	-0.005	0.169	-0.03	0.749	0	1.555	0	0
	(0.006)			(1.082)		(1.166)		
Prop. of men	-0.016***	0.031	-0.516	-5.573**	0.089	-20.258***	0.324	0.004
	(0.002)			(2.793)		(3.011)		
Prop. at right age	0.071***	0.111	0.64	-10.427***	-0.74	-11.696***	-0.83	0.008
	(0.008)			(2.645)		(2.851)		
Prop. who had only public school	0.049***	0.104	0.471	14.493***	0.71	18.928***	0.927	0.004
	(0.007)			(2.352)		(2.535)		
Prop. had already failed	-0.015***	0.066	-0.227	-35.196***	0.528	-38.827***	0.582	0.001
	(0.005)			(1.813)		(1.954)		
Prop. had already dropout	-0.003*	0.024	-0.125	-27.027***	0.081	-23.798***	0.071	0
	(0.002)			(3.758)		(4.051)		
Prop. had late entrance	0	0.014	0	-48.57***	0	-53.593***	0	0
	(0.001)			(5.44)		(5.863)		

Note: Standard deviations in parentheses. School-level variables. ***significance at the 1% level, **significance at the 5% level, *significance at the 10% level.

[17] In 2011, 9.5% of boys and 5% of girls aged 10 to 15 were working (Kassouf, 2015).

Table 10 presents the estimates for the impact of the PEI on other student characteristics. The results indicate that PEI had lessened the proportion of males in schools. Although the coefficient is small, so is the sample standard deviation of this variable, making the ratio $\delta_{x_k} \times \sigma_{x_k}$ is -0.516, a considerable value. As the proportion of boys among working children is higher, this result is in line with the previous one that showed a decrease in the proportion of working students.

Also negative and significant is the estimated impact of the PEI on the proportion of students who have already failed and the proportion of dropouts. Consequently, the impact is positive and significant for the proportion of right-aged students. These results indicate that either the PEI attracted better students, or else it improved these characteristics in students during the period in which it was implemented. It is also observed that the proportion of students who have only studied in public school increased. That is, one hypothesis is that the students attracted by the PEI were the students from other public schools and, according to the previous results, students with higher socioeconomic profile and better performance from these other public schools. Another hypothesis is that the students who stayed in the participants' schools are the ones who have this profile, while others might have been repelled, as mentioned previously.

Table 11 – Estimation of the effect on the Coefficient of Variation

	Dependent variable:			
	Math CV		Portuguese CV	
	(1)	(2)	(3)	(4)
PEI	- 0.001 (0.002)	- 0.003* (0.002)	-0.011** (0.002)	-0.008** (0.002)
Covariates		X		X
Observations	14,469	14,469	14,469	14,469
R^2	0.0001	0.027	0.003	0.066

Note: *p<0.1;**p<0.05;***p<0.01

Note: Standard deviations in parentheses. School-level variables. ***significance at the 1% level, **significance at the 5% level, *significance at the 10% level. All regressions include school fixed effects and time fixed effects

Table 11 presents the results of the evaluation of the impact of the PEI on the coefficient of variation (CV) of the math and Portuguese scores. Columns 1 and 2 show the estimates of the impact of the PEI on the math CV, without and with the use of covariates[18] respectively. Similarly, columns 3 and 4 present the estimates of the impact of PEI on the CV of Portuguese.

The estimates indicate that the PEI decreases the dispersion of the Portuguese and math scores. The impact of the PEI on the CV in terms of sample standard deviations in the models controlling for covariates is 0.167 for math and 0.364 for Portuguese. The only specification that showed a non-significant result was for the CV of mathematics without the use of covariates. This indicates that some of the covariates included in the model varied in schools that received the PEI in the sense of increasing the dispersion of math scores.

8. Discussion

The results found corroborate the hypothesis that the PEI improves the average performance of schools on test scores. We found a positive impact of the program on ninth grade math (0.469 standard deviations) and Portuguese (0.462 standard deviations) scores in treatment schools. This result equals approximately one year of learning for the two subjects, when we compare the differences in scores between the final years of elementary school and high school.[19] In addition, the estimated impact of the program is greater as a school receives the program for a longer period. We also find a significant and negative effect of the PEI on the coefficients of variation of the mathematics grade (0.167 standard deviations), and the Portuguese grade (0.364 standard deviations). Thus, the results indicate that the program increases the mean and reduces the dispersion of test scores.

The estimated impact for PEI is higher when compared to the impacts found in the evaluation of other programs across Latin America. The ave-

[18] The covariates used are the same ones used in the differences-in-differences in Section 7.1.

[19] The average differences in scores between high school and the final years of elementary school are 22.4 and 26.5 points for mathematics and Portuguese, respectively, which is equivalent to 7.45 and 8.83 points on average per year. The average difference was calculated using São Paulo state network and the SAEB editions of 2011, 2013, and 2015.

rage impact estimated by Agüero et al. (2021) for the La Jornada Escolar Completa program is 0.24 standard deviations in the math score and 0.15 in the language score. Controlling for observable characteristics, the estimated average impact of the PEI almost doubles the estimated impact for La Jornada Escolar Completa for math, and more than doubles for language. The difference in results may be driven by the unique characteristics of the PEI.

Our results are also higher than those identified by Rosa et al. (2022), which found that the full-day high school in Pernambuco increased by 0.22 and 0.19 standard deviations in mathematics and languages test scores, respectively. The difference in the results can be driven by two factors. First, although Pernambuco and PEI full-time school programs share common characteristics, there might be heterogeneity in the implementation and school's adherence to the program, leading to different results. Second, we analyze the impact on lower secondary school (9th grade), while Rosa et al. (2022) estimates the impact for high school. Evidence shows that it may be more difficult to advance on the SAEB scale when the score is higher. If this fact is indeed observed, then if an equal increase in effort occurred for all students in all grades (or an equivalent improvement in the quality of education), one would expect the increase in proficiency to be greater in the early grades (where proficiency is lowest) than in the higher grades.[20] In that sense, we may expect the interventions to increase test scores may have a higher impact on earlier grades.

In the compositional analysis, the results indicate that schools receiving the PEI had a lesser drop in the number of students and had a greater drop in the number of classes than control schools. These impacts are accompanied by a negative impact in the number of teachers per class and staff per student. The program also seems to attract a higher proportion of stu-dents with a higher socioeconomic profile, measured by the increase of the proportion of students with computers, TVs, and with highly educated mothers. However, this change in composition is not the driver of the es--timated effect, given that the impact evaluation method used controls for these observable characteristics. The drivers of the estimated effect may come from the unique characteristics of the PEI. For example, the regime of exclusive dedication for teachers can lead to an improvement in the quality of classes, since the teacher manages their time in only one school, not spending time commuting, and can improve their productivity. Besides

[20] See Fernandes and Gremaud (2020).

this, the increase in salaries can be a stimulus to improve the quality of the classes. Another incentive is the internal evaluation, since teachers are evaluated by their own colleagues and by the students.

Still regarding teachers, although we controlled for training, we did not control for experience. A minimum of three years of experience is required to be a teacher at a school which receives PEI. Thus, part of the effect also comes from this characteristic. Furthermore, when estimating the effect of the program, we did not control for teacher turnover. In the program, teachers are assigned to the same school for at least three years, and there is an absence of teachers hired under temporary contracts. Thus, in future research it is worth investigating whether teacher tenure in the PEI school is longer, and whether this tenure has an impact on proficiency.

The diversified curriculum of the program, as well as the pedagogical proposal of placing the student as the protagonist, may also explain part of this estimated effect. This hypothesis is substantiated by the result of Kawahara (2019), which evaluates a full-time school program with pedagogical features in common with the PEI (it also incorporates the concept of "Life Project"), and finds positive effects on student performance.

Because of these characteristics, the effect of the PEI is believed to differ from the effect of other full-time school programs. In the estimated results we find no significant impact of the regular full-time school (school day of longer than 7 hours) on scores. This corroborates the literature, which argues that increasing the school day alone is not an effective policy for improving grades (Levin and Tsang, 1987). Furthermore, the PEI differs from Mais Educação, which appears to have no impact on performance[21], and ETI, which despite having effects on math scores, are considerably smaller than the effect of the PEI. In addition to the smaller number of changes that the ETI brings to the school compared to the PEI, part of the difference in impact between the programs can be explained by the smaller number of students per school covered by the ETI.[22]

[21] (Xerxenevsky, 2012; Aquino et al., 2015; Almeida et al., 2016; de Oliveira et al., 2016).
[22] While the PEI covers an average of 338 students per school, the ETI covers an average of 212 students (Governo do Estado de São Paulo/SEE, 2018).

9. Conclusion

Although the results presented here are robust to different methodological specifications, some limitations are worth noticing. The first limitation is that we can't explore the drivers of the result. Our results can be driven by several different factors (e.g., enhancement of teacher quality, curriculum changes, or pedagogical structure) that could not be disentangled. Second, non-observable factors that vary over time that affect students' performance can bias our results. For example, if full-time schools attract more motivated students, and if this is not captured by our students' socioeconomic covariates included in the model, our estimates can be biased upwards. The third limitation is that we used public data that doesn't allow us to assign the treatment to the student. If this were possible, we could include students' fixed effects and control for these non-observable factors, such as motivation. Also, we could explore in more detail the changes in the composition, perceiving if PEI attracted higher socioeconomic students and expelled disadvantaged students. Furthermore, it would be possible to estimate heterogeneous effects, perceiving if the enhancement in the test scores is driven by the students that were already top-performance before the program's implementation. If the panel-data at the student level is available, further research can be dedicated to analyzing PEI heterogeneous effects and the gross changes in composition.

It is worth noting that the PEI difference from the other programs comes at a higher cost. While the average annual cost per student in a part-time state school is U$1393, and in a school that has the ETI is U$1474, the average annual cost of the PEI is U$1869, 34% higher than the part-time state schools average (Governo do Estado de São Paulo/TCE, 2016).[23] The program's high cost can be seen as a motivation for targeting the program on the poorest. Future work can simulate the impact of PEI if targeted only on the most vulnerable schools.

However, it is also important to highlight different benefits that the PEI can generate in the long term. Micro evidence shows that school performance has an impact on future wages, even controlled for years of schooling (Curi and Menezes-Filho, 2014). Hanushek and Woessmann (2008) also describe evidence of a positive relationship between test scores (cognitive skills) and school attainment. And, if this positive relationship between test score and school entertainment is valid, it is important to men-

[23] The values were converted using the exchange rate from December 30, 2016.

tion Lochner (2011) who deals with some of the nonproduction benefits of education, especially on crime and health. Macro evidence also shows higher economic growth for countries with better educational quality [see again Hanushek; Woessmann, 2008 who extended the analysis of E. A. Hanushek (2000) to a larger number of countries]. The comparison between the costs and benefits of the PEI – and then the comparison with the best alternative use of the resource – although outside the scope of this article, would certainly contribute to the debate related to the expansion of the integral education policy.

Finally, this paper contributes to the policy discussion in two aspects. First, it verifies the success of the policy, in terms of test scores, which can be replicated in other states or countries. Second, the finding that PEI attracted students of higher socioeconomic status, opens the discussion to the challenge of implementing policies that include, in its conception, individuals of low socioeconomic status.

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Appendix

1.1. Estimation results with all covariates

Table 12 – Results with all covariates

	Dependent variable:			
	mathematics scores		Portuguese scores	
	(Dif-Dif)	(Caliper)	(Dif-Dif)	(Caliper)
PEI	7.069***	7.830***	6.979***	8.406***
	(0.838)	(1.327)	(0.903)	(1.374)
Prop. illiterate mothers	−26.764***	−7.975	−26.943***	−16.917
	(4.100)	(13.195)	(4.419)	(13.654)
Prop. mothers with higher education	19.166***	17.190***	22.664***	20.670***
	(2.142)	(6.654)	(2.309)	(6.886)
Prop. who work	−16.520***	−17.817***	−30.811***	−40.396***
	(1.918)	(5.920)	(2.067)	(6.126)
Prop. with domestic worker	−17.054***	−4.070	−25.666***	−8.239
	(2.259)	(7.195)	(2.435)	(7.446)
Prop. with Fridge	−0.070	6.335	−2.170	10.315
	(4.153)	(12.604)	(4.476)	(13.043)
Prop. with TV	0.833	-6.973	8.733**	4.663
	(3.778)	(11.872)	(4.072)	(12.285)
Prop. with Computer	18.897***	19.304***	17.148***	13.111***
	(1.540)	(4.702)	(1.660)	(4.866)
Mean No. of bathrooms	3.534***	6.421**	2.541***	3.391
	(0.879)	(2.749)	(0.947)	(2.845)
Prop. who use public transport	−1.500	−1.567	−2.265**	−4.907
	(1.004)	(3.268)	(1.082)	(3.382)
Regular full-time	−0.031	−1.228	−0.450	−2.122
	(0.743)	(1.484)	(0.801)	(1.536)
Prop. white	0.749	6.574	1.555	2.638
	(1.082)	(4.063)	(1.166)	(4.204)
Prop. of men	−5.573**	−3.977	−20.258***	−8.953
	(2.793)	(9.117)	(3.011)	(9.435)
Prop. at right age	−10.427***	−20.223**	−11.696***	−23.119***
	(2.645)	(7.953)	(2.851)	(8.230)
Prop. who had only public school	14.493***	21.578***	18.928***	20.654***
	(2.352)	(6.865)	(2.535)	7.104)
Prop. had already failed	−35.196***	−46.752***	−38.827***	−49.978***
	(1.813)	(5.569)	(1.954)	(5.763)
Prop. had already dropout	−27.027***	−17.380	−23.798***	−22.952*
	(3.758)	(11.700)	(4.051)	(12.107)
Prop. had late entrance	−48.570***	−44.965**	−53.593***	−47.372***
	(5.440)	(17.710)	(5.863)	18.326)
Has computer lab.	−0.213	3.602	−0.722	1.141
	(0.531)	(2.201)	(0.573	(2.277)
Has science lab.	0.068	−0.253	0.303	−0.497
	(0.319)	(0.964)	(0.343)	(0.997)
Has library	−0.581*	1.564	−0.259	1.584
	(0.304)	(1.036)	(0.328)	(1.072)

Table 12 – Results with all covariates (*Cont*.)

No. staff per student	2.459 (3.144)	−1.800 (9.272)	0.544 (3.389)	−5.286 (9.595)
Has sport court	0.497 (0.706)	−4.006 (3.396)	0.845 (0.760)	−3.322 (3.514)
No. classes	0.176*** (0.035)	0.255* (0.154)	0.191*** (0.037)	0.225 (0.159)
Prop. teachers with graduation	0.092 (1.718)	8.836* (4.746)	−0.963 (1.852)	2.501 (4.911)
No. teachers with graduation per student	−4.077 (5.861)	−31.461** (14.002)	−0.734 (6.317)	−10.830 (14.489)
Observations	14,469	1,440	14,469	1,440
R^2	0.178	0.241	0.207	0.274

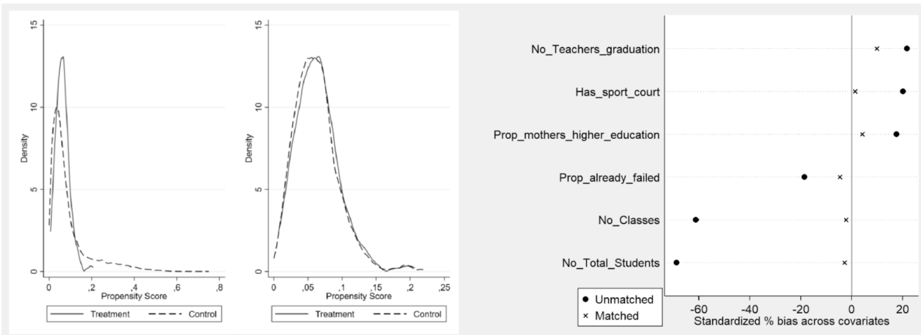
Note: *p<0.1;**p<0.05;***p<0.01
Note: Standard deviations in parentheses. School-level variables. ***significance at the 1% level, **significance at the 5% level, *significance at the 10% level. All regressions include school fixed effects and time fixed effects.

1.2. Matching

Table 13 – Covariates balance

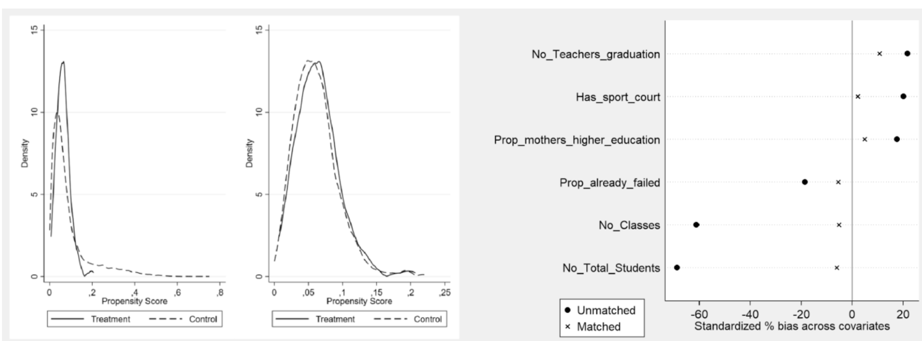
	Before Matching			After Matching			
	Mean Treatment	Mean Controls	Mean difference	Mean Treatment	Mean Controls	Diff. Of means	% reduction
Distance	0.06	0.04	0.02	0.06	0.06	0.00	99.97
No. total students	364.30	506.48	-142.18	364.30	355.10	9.20	93.53
Prop. mothers with higher education	0.05	0.04	0.01	0.05	0.05	0.00	87.71
Prop. had already failed	0.14	0.15	-0.01	0.14	0.15	0.01	40.56
Has sport court	0.99	0.95	0.04	0.99	0.98	0.01	79.10
No. classes	11.40	14.71	-3.31	11.40	11.24	0.16	95.19
No. teachers with graduation	0.08	0.07	0.01	0.08	0.07	0.01	41.47

1.3. Others Matchings



(a) Common Support (b) Covariates Balance

Figure 4 – Common Support and Covariates Balance - Kernel



(a) Suporte Comum (b) Covariates Balance

Figure 5 – Common Support and Covariates Balance - Radius

Table 14 – Hit or Miss

		True value:	
		PEI	*Not-PEI*
Predicted	*Not-PEI*	2172	33
Value:	*PEI*	1371	102

Sensitivity	Specificity	Precision
0.613	0.760	0.985

1.3. Variables definitions

1. School census variables

- No. total students: number of students from 6th to 9th grade
- No. teachers: number of teachers from 6th to 9th grade
- No. staff: number of staff in school (includes teachers)
- No. classes: number of classes in school
- Prop. of men: proportion (from 0 to 1) of students from 6th to 9th grade who are male
- Prop. teachers with graduation: proportion (from 0 to 1) of teachers from 6th to 9th grade who have a specialization, or master's or doctoral degree
- Prop. who use public transport: proportion (from 0 to 1) of students from 6th to 9th grade who use public transport to go to school
- Has sport court: dummy variable (0 or 1) indicating if the school has sport court
- Has computer lab.: dummy variable (0 or 1) indicating if the school has a computer laboratory
- Has science lab.: dummy variable (0 or 1) indicating if the school has a science laboratory
- Has library: dummy variable (0 or 1) indicating if the school has a library
- Regular full-time: dummy variable (0 or 1) indicating if the school has at least one final year elementary school class with a school day longer than 7 hours.

2. SAEB variables

- Prop. mothers with only high school: proportion (from 0 to 1) of ninth-graders students that report their mother (or the caregiver woman) has no school, or lower secondary school or complete high school

- Prop. mothers with higher education: proportion (from 0 to 1) of ninth-graders students that report their mother (or the caregiver woman) has completed higher education
- Prop. illiterate mothers: proportion (from 0 to 1) of ninth-graders students that report their mother (or the caregiver woman) is illiterate
- Prop. at right age: proportion (from 0 to 1) of students 15 years old or younger in the year of reference (the right age for 9th grade is 14).
- Prop. who work: proportion (from 0 to 1) of ninth-graders students that work outside the household
- Prop. had late entrance: proportion (from 0 to 1) of ninth-graders students that entered after the 1st year of elementary school
- Prop. who had only public school: proportion (from 0 to 1) of ninth-graders students who had studied only in public schools
- Prop. had already failed: proportion (from 0 to 1) of ninth-graders students who had already failed at least one time
- Prop. had already dropout: proportion (from 0 to 1) of ninth-graders students who had dropout school
- Prop. with Fridge: proportion (from 0 to 1) of ninth-graders students who have a fridge in the household
- Prop. with TV: proportion (from 0 to 1) of ninth-graders students who have a TV in the household
- Prop. with Computer: proportion (from 0 to 1) of ninth-graders students who have a computer in the household
- Prop. with domestic workers: proportion (from 0 to 1) of ninth-graders students who have domestic workers in the household
- Mean No. of bathrooms: average number of bathrooms in ninth-graders students' households