The Impact of Structured Teaching Methods on the Quality of Education[*]

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Resumo

Este trabalho estima o impacto da utilização de métodos estruturados na qualidade da educação dos estudantes do ensino fundamental nas escolas públicas do Estado de São Paulo. Os métodos estruturados englobam uma série de instrumentos pedagógicos e administrativos ao sistema educacional. Nos últimos anos diversos municípios do Estado de São Paulo contrataram sistemas de ensino privados para implementar tais métodos em seu sistema escolar. Sua proposta pedagógica envolve a estruturação de conteúdos curriculares, elaboração e utilização de livros textos para professores e alunos, e treinamento e supervisão de professores e instrutores. Utilizando a estratégia de estimação de diferença em diferenças encontramos que os estudantes da 4ª e 8ª séries dos municípios que adotaram métodos estruturados tiveram um desempenho melhor em matemática e português do que os estudantes em municípios não expostos aos métodos. Não encontramos diferenças nas taxas de aprovação. No entanto, os testes de robustez não nos permitem descartar a possibilidade destes resultados se deverem a viés de auto-seleção.

Palavras chave: qualidade da educação, métodos estruturados
Código JEL I21, I28

Abstract

This paper estimates the impact of the use of structured methods on the quality of education of the students in primary public school in Brazil. Structure methods encompass a range of pedagogical and managerial instruments applied to the education system. In recent years, several municipalities in the State of São Paulo have contracted out private educational providers to implement these structured methods in their schooling system. Their pedagogical proposal involves structuring curriculum contents, elaboration and use of teachers and students textbooks, and training and supervision of the teachers and instructors. Using a difference in differences estimation strategy, we find that the fourth and eighth grader students in the municipalities with structured methods performed better in Portuguese and Math than students in municipalities not exposed to the methods. We find no differences in approval rates. However, the robustness tests do not allow us to rule out the possibility of self-selection bias to drive our results.

Keywords: quality of education, structured methods.
JEL Codes: I21, I28.

I.   Introduction

The quality of education in Brazil is low by several international comparisons. For instance, Brazil ranked 53th in Math proficiency among all 57 participant countries in the 2006 PISA Exam.[1] In the attempt to overcome this disadvantage several policies have being adopted by Brazilian policy makers. Among them, the decentralization of educational system was pervasive. The states transferred the control of the primary school system, 1st to 8th grades, to the municipalities. In some states the municipalities have autonomy to choose the pedagogical material and part of the curriculum contents under the federal regulation standards. This autonomy includes the possibility of contracting out educational services from private organizations. In the state of São Paulo, in the last ten years around one third of the municipalities have hired private institutions that provided structured teaching methods to the public system. These institutions provide textbooks for the students, pedagogical materials for the teachers that systematize classes, homework materials and answer keys, etc. They also coach the teachers on the use of these materials.

The international evidence on the impact of school inputs on students' outcomes, particularly on provision of pedagogical material, like textbooks and teachers in training services is ambiguous. Early studies, surveyed by Lockheed and Hanushek (1987), show that textbooks provision was, on average, the most cost effective program compared to teachers training, interactive radio, technical schools, peer tutoring and cooperative learning in some developing countries. The World Bank (2002) reports studies in the same direction: in Philippine the provision of multilevel material combined with parents and teachers partnership had a positive impact in reducing drop-out rates and improving test scores. It also showed to be more cost effective than the sole provision of textbooks. In Nicaragua a textbook provision program with monitoring of their use in classroom had a positive effect on student scores but it was less effective than radio instructional program. A more recent study in Kenya reported by Glewwe, Kremer, Moulin (2007) shows that the provision of textbooks had a positive impact only on the performance of the top students. The impact of teachers in-service training on students' performance is also ambiguous. Angrist and Lavy (2002) show that an in-service training in Jerusalem improved test scores of elementary public schools students and was more cost effective than reducing class size or lengthening the school day. On the other hand, Jacob and Lefgren (2002) find no impact of marginal increases in in-service teachers training in the performance of students in Chicago public school system.   These results altogether seem to point that combined policies are more effective than isolated ones and this is the central feature of the structured teaching methods analyzed in this study. The curriculum organization, the provision of pedagogical material and teachers training are the main components of the structured method programs.

The purpose of this paper is to estimate the impact of structured teaching methods on the proficiency of students in municipal school system in the State of São Paulo, Brazil. The paper is organized as follows: section two discusses structured teaching methods that several São Paulo State municipalities have adopted in agreements with private teaching systems. Section three describes the dataset and the sample used in the analysis. Section four presents a descriptive analysis of the

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[1] See PISA (2006).

participating and non-participating municipalities and their observed characteristics associated to the adoption of structured methods. Section five describes the methodology used to identify the impact of these teaching methods on student proficiency. Section six discusses the main results. Section seven presents the robustness checks. Finally, the last section concludes the study.

II. Private Teaching Systems and Structured Methods

During the 1980s and 90s private learning institutions that market their learning materials and pedagogical proposal signed agreements with independent private schools that could adopt a teaching "method" as well as a brand associated with the selected teaching system. In the late 1990s, with the strong incentives for decentralization and educational autonomy given to the municipalities, those agreements were extended to the public school system in some states of Brazil, mainly in São Paulo.

The pedagogic proposition of private teaching systems involves structuring curriculum contents and learning activities by means of learning materials intended for students and instructors. Teaching systems also provide offer teachers instruction and pedagogic advice, in addition to access to an education portal along with the materials. It is worth noting that differences between agreements may lead to differences not only in the materials and training the various teaching systems provide, but also between different municipalities served by the same system. The amounts charged, between R$150 and R$200 per student/year, also reflect the variation, represent about 10% of the cost per student/year in the public sector.

Learning Materials

Teaching systems propose to offer an integral set of learning materials with content for every subject and grade, prepared by internal teams under centralized coordination. The contents are divided into booklets covering regular periods (usually of two months) and organized by grade and by subject. Therefore, the booklets include content by area and provide a class plan, since one booklet must be completed and another begun every two months.

Furthermore, teaching systems also offer instructors support materials. In general, these materials are intended to clarify the class plan implied in student booklets by offering instructors not only a suggested teaching sequence, but also methodological strategies for each topic and supplemental activities to be undertaken with students.

Instructor Training and Advice

Teaching systems also offer instructor training and advice services. In general, these services involve meetings every two or six months with all the instructors in the network, divided by areas and grades. At these meetings, instructors from the teaching systems address different methodological strategies to convey the contents of learning materials. Some teaching systems carry out bimonthly visits to classes to monitor instructors and address doubts they may have. Others offer a permanent consultant in each city to support instructors and track the entire teaching process. Systems with virtual graduate or specialization programs offer scholarship grants to instructors and headmaster of the municipalities with which they maintain agreements.

Other mechanism system offers consists in interactive portals intended to add depth to booklet contents, with supplemental activities, texts, documents and education-related articles, test-question banks, areas where schools can exchange experiences and where instructors can ask questions and have them answered. Some systems also offer online content for students.

Although each teaching system has unique features, the class load and type of training and support offered in each municipality may vary depending on the agreement between each specific municipality and the teaching system.

III. Data Collection and Database

The data base used in this study was built from several source: the survey on several educational programs made by the São Paulo State Audit Court – TSE SP, survey with its affiliated by the Union São Paulo State Municipal Education Officials, direct contact with some teaching systems and direct contact with the municipalities. Our database has information on standing agreement between each municipality and the teaching system; period and scope (Kindergarten, Grade School, High School, and Adult Education) for each municipality.

Primary public education in Brazil is divided in two systems: one subordinated to the state educational authority and the other to the municipality educational authority. Therefore municipalities have schools belonging to one of these systems or to both. According to our survey, in the State of São Paulo, 79 municipalities had only schools belonging to the state system, 396 to the municipal system and 170 with both. Out of the 566 municipalities with schools in the municipal system, 189 had some kind of structured method agreement between 1999 and 2008. Over this period, 13 municipalities terminated their agreements, and one of these resumed it after one year. Therefore, in 2008 177 municipalities (around 30 percent) had some kind of agreement in place, covering approximately 440 thousand students in the State's municipal system, equal to 14 percent of those enrolled in municipal systems and 8 of all public school (state and municipal) enrollments. Figure 1 shows how the figures evolved over the years:

Figure 1 Teaching systems evolution in São Paulo municipalities 1998-2008)
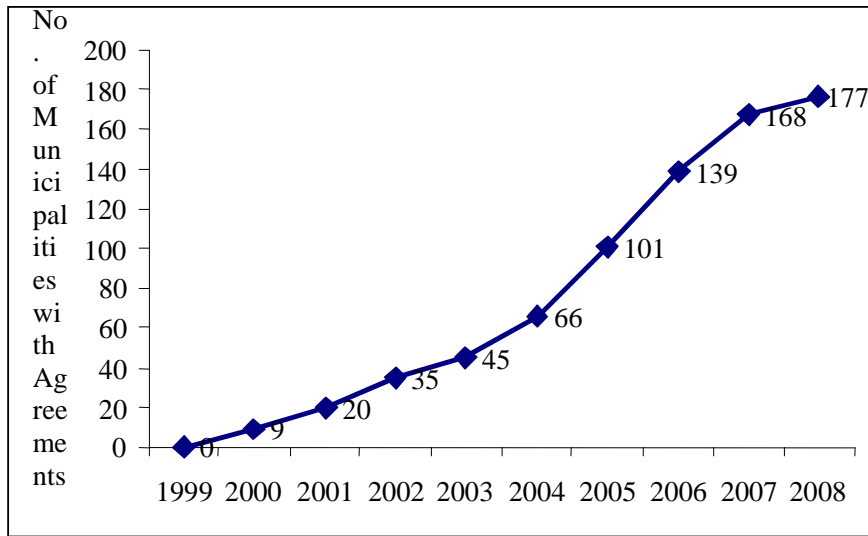
The annual flow of municipalities adopting structured methods can be seen in Table 1, next. As ca be seen, the years 2005-2007 show a concentration of municipalities adopting methods, and 2008 shows a concentration of terminations.

Table 1: Annual Flow of Municipalities with Structured Method Agreements
All Municipalities

	Entry	Termination	Total
1999	3	0	3
2000	6	0	6
2001	11	0	11
2002	15	0	15
2003	11	1	10
2004	21	0	21
2005	36	1	35
2006	40	2	38
2007	31[2]	2	29
2008	16	7	9
Total	190	13	177

On the other hand, most of these municipalities (94%)have agreements in force for 1st-4th grades, as this is the education level with the highest municipalization rate statewide. Even so, 75 percent of these adopt structure methods for Kindergarten and 48 percent do so for grades 5 through 8.

IV Descriptive Analysis

This section provides a descriptive analysis comparing municipalities with structured methods signed between 2006 and 2007 and the municipalities without structured methods by 2007. The first thing to notice is that, while all municipalities

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[2] These 31 municipalities include the municipality of Registro, which had had an agreement in place in 2001 and 2005 and resumed it in 2007

with municipal education system schools participated in Prova Brasil 2007, in the exam of 2005, 86 of these municipalities didn't participate. When we investigate which characteristics affect the probability to participate in the 2005 exam we observe that the having schools ran only by the municipal system is significant at 5% level and the average schooling of the population at 10% level .[3]

Table 2: Probit Model - Participation in Prova Brasil 2005

Variables	dy/dx	dy/dx
Population (1000 hab.)	0,0000	-0,00011
	(0,0002)	(0,00021)
% Population 7 to 14 years old	-0,5212	0,00155
	(0,5490)	(0,90405)
Population Average Schooling	0,0644*	0,07194*
	(0,0341)	(0,04533)
Population Per capita Income	-0,0006	-0,00056
	(0,0003)	(0,00043)
% Poor	-0,0192	-0,09944
	(0,2163)	(0,31388)
Only School Municipal System	0,1300**	0,00002**
	(0,0420)	(0,00003)
School Age Per capita Education Expenditure		-0,00007
		(0,00003)
Per capita Municipal Revenue		0,16846***
		(0,06209)
Y predicted	85,63	85,15
Pseudo R^2	0,0315	0,072
N	458	360

Note: *** p<0.01, ** p<0.05, * p<0.1.
Standard deviations in parentheses.

.If we include the municipality's per capita revenue and expenditures in education by the population in school age we restrict our sample to 449 municipalities but we also observe that per capita revenue of the municipality has a significant, although very small, negative impact in the probability of participating in the exam. As a result of some municipalities not participating Prova Brasil 2005 our sample was reduced from 70 municipalities that signed structured methods agreements in 2006 and 2007 to 59 for the 4th grade and 33 for the 8th grade, and from 392 municipalities that haven't signed agreement by 2007 to 332 for the 4th grade and 126 for the 8th grade.

In terms of the characteristics of the municipalities that signed structured methods agreements in 2006 and 2007 and the municipalities without structured methods by 2007 and restricting our analysis only to the municipalities which participated in Prova Brasil 2005, Table 2 shows that the two groups are very similar in terms of average schooling, percentage of poor in the population and percentage of population in school age. The largest differences are the smaller size of the population, the higher education expenditure and the lower presence of state managed schools in the municipalities that adopted structured methods.

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[3] At the municipality level we have few variables to use in the analysis.

Table 3 : Municipality Characteristics

	Without Structured Methods in 2007			Structured Methods in 2006 and 2007		
	Mean	SD	N	Mean	SD	N
Total Population (1000 hab)	53,37	115,38	332	28,42	38,31	59
% Population Poor	0,21	9,43	331	0,20	8,57	58
Years of Schooling	5,37	0,92	331	5,32	0,77	58
Per capita Income	278,28	85,73	331	282,25	106,38	58
% Population 7 to 14 years old	0,14	0,03	332	0,14	0,03	59
Per capita Revenue	1663,,28	690,00	263	1764,59	821,07	45
School Age per capita Education Expenditure	2203,50	1142,22	266	2656,16	1747,14	43
School Municipal System Only	0.684	0.466	332	0.814	0.393	59

Source: Population, Years of Schooling, Per Capita Income: Censo Demográfico 2000-IBGE;
% Poor – IPEADATA; Revenue and Education Expenditure: Fundação SEADE

The analysis of the joint impact of theses variable, controlling for the results of Prova Brasil 2005 and approval rates 2005, on the probability of the municipality to adopt structured methods, using a probit model, shows that the only variable significant at 10% is the absence of state managed schools, when we include educational expenditures and per capita revenue of the municipalities.

Table 4: Probit Model - Structured Method (2006-2007)

	dy/dx	
Approval rate 4th grade	-0,00262	-0,00433
	(0,00317)	(0,00342)
Prova Brasil 05 Math	-0,00416	-0,00456
	(0,00271)	(0,00304)
Prova Brasil 2005 Portuguese	0,001749	0,002273
	(0,00313)	(0,00345)
Population	-0,00054	-0,00028
	(0,00038)	(0,00037)
% 7 to 14 years old Population	-0,55271	0,727242
	(0,65191)	(100.714)
Average Years of Schooling	-0,02094	-0,03769
	(0,04358)	(0,04814)
Average Per capita Income	0,000334	0,000426
	(0,00041)	(0,00047)
% Poor Population	-0,23701	-0,5033
	(0,28066)	(0,34432)
School Municipal System Only	0,06095	0,075361*
	(0,0413)	(0,04665)
School Age per capita Education Expenditure		0,00003
		(0,00002)
Per capita Revenue		-0,00005
		(0,00004)
Y predicited	13,64	12,08
Pseudo R^2	0,0416	0,0739
N	389	302

Note: *** p<0.01, ** p<0.05, * p<0.1.
Standard deviations in parentheses.

V.   Methodology: The Difference-in-Differences Estimator

The ideal strategy of estimating the causal effect of the adoption of structured methods on the quality of education would be to observe municipalities with and without the use of methods at a given point in time. This, however, is impossible. Therefore, we must resort to creating comparison groups (control groups) as similar as possible to the municipalities with structured methods in place (treatment group) to build counterfactuals. The key assumption to identify the causal impact of the methods is that the control groups behave as the treatment group in the absence of the treatment. To control for unobserved characteristics that differently affects the level of proficiency on each groups, we adopt the difference-in-differences estimator with fixed municipality effect. Intuitively, this estimator is the difference between proficiency gains over time of municipalities with structured methods and the proficiency gains of municipalities without such agreements over the same period. This difference can only be understood as the true impact of methods adoption under the assumption that, had the treatment group not adopted structured methods, the gain in proficiency would be the same as in municipalities in the control group.

The relevant variables for analysis are average student approval rates between the first and fourth grades and the average proficiency scores in Mathematics and Portuguese attained by 4th and 8th graders measured by the Prova Brasil. In this study, we estimate the impact of methods on schools adopting them in 2006 and 2007.

Impact estimation is based on the following fixed-effect regression using 2005 and 2007 data:

$$y_{it} = \alpha + \beta d_{it} + \delta T_t + \lambda_i + u_{it} \qquad (1)$$

where y_{it} is one of the variable of interest (approval rate, Math proficiency or Portuguese proficiency) for municipality i in year t (2005 and 2007); d_{it} is a dummy assumes value 1 if municipality i had a structured method in place in year t, the coefficient β captures the additional gain the treatment group showed relative to the mean of control municipalities (the difference-in-differences estimator). The dummy T_t equals 1 if t is 2007 and zero if t is 2005, the coefficient δ captures the average change in results from 2005 to 2007 for control-group municipalities. λ_i is the fixed effect, that is, a variable that captures municipality i's unobserved fixed characteristics; u_{it} is the random term. The regression was estimated with municipalities that had never had contracted out the structure methods prior to 2006. The relevant parameter is the β, which measures the change in approval rates or proficiency scores induced by the adoption of the methods.

VI.   Results

VI.1. The Impact of Structured Methods

Table 6a shows the average and standard deviation of the approval rate, Math and Portuguese proficiency in 2005 and 2007 for students in the 4th grade. It can be noticed that, for the 4th grade, the gains in Math and Portuguese in the treatment group were higher than the control one. The treatment group presents lower levels of proficiency in 2005 and depicts higher levels after the implementation of the structured

methods in 2007. Differently, no gains are seen in the approval rates for both control and treatment groups in the period.

<div align="center">Table 6a : Average 4th grader performance</div>

	Municipalities without Structured Methods by 2007			Municipalities with Structured Methods in 2006-2007		
	2005 Approval (%)	**Prova Brasil Exam 2005** Math	Portuguese	**2005** Approval (%)	**Prova Brasil 2005** Math	Portuguese
Mean	91.43	195.15	185.93	90.84	192.86	184.65
SD	5.35	14.13	12.44	5.61	10.59	9.25
N	332	332	332	59	59	59
	2007 Pass	**Prova Brasil 2007** Math	Portuguese	**2007** Pass	**Prova Brasil 2007** Math	Portuguese
Mean	92.76	207.46	186.25	92.2	210.14	188.43
SD	4.93	19.14	14.34	4.81	18.14	12.26
N	391	391	391	70	70	70

Table 6b shows the same statistics for the students in the 8th grade. Again, it can be seen that the average scores in Math and Portuguese were lower in the treatment group than in the control group in 2005 and higher in 2007 and there is no gain in approval rate for both groups.

<div align="center">Table 6b: Average 8th grader performance</div>

	Municipalities Without Structured Methods in 2007			Municipalities With Structured Methods in 2006 and 2007		
	2005 Approval (%)	**Prova Brasil 2005** Math	Portuguese	**2005** Approval (%)	**Prova Brasil 2005** Math	Portuguese
Average	86,32	248,16	229,93	85,70	244,34	226,31
SD	7,88	15,35	12,83	5,79	13,34	12,36
N	98	98	98	21	21	21
	2007 Approval Rate	**Prova Brasil 2007** Math	Reading	**2007** Approval Rate	**Prova Brasil 2007** Math	Reading
Average	88,46	248,85	234,69	88,79	252,49	235,80
SD	6,54	16,01	14,77	8,04	19,44	17,05
N	126	126	126	33	33	33

The regression was estimated using all municipalities in the treatment group that have adopted structured methods in 2006 and 2007 in any grade. Table 7 shows the regression results. The estimation was run for the approval rates of the students in 1st-4th grades and 5th-8th grades and for the scores of Prova Brasil exam for the 4th and 8th. The results reinforce the figures shown in Table 6. It indicates that the impact on approval rates, though positive, is not statistically significant. They also show a positive impact of 4.7 and 3.4 points in 4th Math and Portuguese Prova Brasil exams scores respectively. For 8th graders the impact on Prova Brasil exam Math and Portuguese scores is also positive at 6.3 and 4.9 points, respectively. These results are notable. One way of measuring the relative importance of the impact is to express these gains in terms of the standard deviation of Prova Brasil proficiency scores. In 2005, the nationwide standard deviation of Portuguese and Math scores were of approximately 40 points in each case, for both 4th and 8th graders. Therefore, the impact of adopting structured method agreements corresponds to about 10 percent of the standard deviation. For example, the impact on 4th grade math scores is 4.7/40 = 0.1175.

Table 7: Municipal Fixed-Effect Regression: Expanded Sample

	4th Grade			8th Grade		
	Approval Rate (1st-4th)	Math Proficiency	Portuguese Proficiency	Approval Rate (5th-8th)	Math Proficiency	Portuguese Proficiency
Structured method	0.626	4.712**	3.353**	2.077	6.261**	4.921*
	(0.655)	(2.284)	(1.624)	(1.596)	(2.928)	(2.660)
2007	1.342***	12.679***	0.569	1.481**	3.058**	6.955***
	(0.255)	(0.887)	(0.631)	(0.670)	(1.230)	(1.118)
Constant	91.336***	194.802***	185.738***	86.408***	246.217***	227.933***
	(0.169)	(0.591)	(0.420)	(0.456)	(0.836)	(0.760)
N	782	782	782	278	272	272

Note: *** p<0.01, ** p<0.05, * p<0.1.
Standard deviations in parentheses.

To check the sensitivity of the results to sample-selection bias, we replicate the procedure with a restricted sample including only municipalities with agreements in place for each of the analyzed grades. The treatment group for the 4th grade analysis included only municipalities with methods in place for the 4th grade, and likewise for the 8th grade analysis. The total number of municipalities in the restricted sample is can be seen in Table 8.

Table 8: Number of Municipalities, Restricted Sample

	4th Grade		8th Grade	
	Total	With Prova Brasil	Total	With Prova Brasil
Treatment	65	54	30	26
Control	392	332	332	100

The results for the restricted sample increases the estimated impact of methods to 5.3 points in the 4th grade Prova Brasil exam (Math) and keeps the impact on Portuguese scores at 3.4 points. The impact on average 1st-4th grade approval rates remains statistically no different from zero. For the 8th grade, results indicate 8.58 and 5.5 higher scores in math and Portuguese respectively. Approval rates are 2.9 percentage points higher and statistically significant at 10 percent. Table 9 depicts the results. Comparing with extended sample, we find higher impacts of the structured methods in all but one quality of education indicators. These results are expected since in the restricted sample the method was adopted in the examined grade. Although it is possible that externalities of having structured methods adopted in different grades affects the quality of education of students in a given grade, the direct impact of the methods are more effective.

Table 9: Municipal Fixed-Effect Regression: Restricted Sample

	4th Grade			8th Grade		
	Approval Rate (1st-4th)	Math Proficiency	Portuguese Proficiency	Approval Rate (5th-8th)	Math Proficiency	Portuguese Proficiency
Structured method	0.582	5.301**	3.383**	2.973*	8.584**	5.488*
	(0.682)	(2.377)	(1.692)	(1.733)	(3.368)	(3.088)
2007	1.342***	12.679***	0.569	1.481**	3.058**	6.955***
	(0.255)	(0.889)	(0.633)	(0.631)	(1.227)	(1.125)
Constant	91.350***	194.860***	185.781***	86.492***	246.146***	227.945***
	(0.171)	(0.596)	(0.424)	(0.440)	(0.855)	(0.784)
Observations	772	772	772	252	252	252

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

Standard deviations in parentheses.

VI.2. The Heterogeneous Effect of the Starting Point

This section extends the analysis of the impact of structured methods on student proficiency to determine whether the impact varies for municipalities with different initial levels of proficiency. The question is whether structured methods have a greater impact on municipalities with higher or lower initial Prova Brasil exam scores. To test whether the impact of structured methods differs for various proficiency levels, we include in the analysis the interaction of 2005 Prova Brasil scores with the treatment group:

The estimated regression is:

$$y_{it} = \alpha + \beta d_{it} + \varphi d_{it} PB_{i05} + \delta T_t + \lambda_i + u_{it} \qquad (3)$$

This estimation provides the impact, conditioned on 2005 Prova Brasil exam scores, of structured methods on students proficiency. Again, the analysis was applied

to both samples: (i) the expanded one, where treated municipalities are the ones with methods on any grades; and (ii) the restricted one, where treated municipalities are the ones with methods in place for the analyzed grades only.

For the expanded sample, Table 10 shows that the interaction is not statistically significant for 4th grade Math Prova Brasil scores, but is for Portuguese Prova Brasil scores with a negative impact. This means that impact is greater for less proficient municipalities. The same result occurs for Math and Portuguese 8th grade scores.
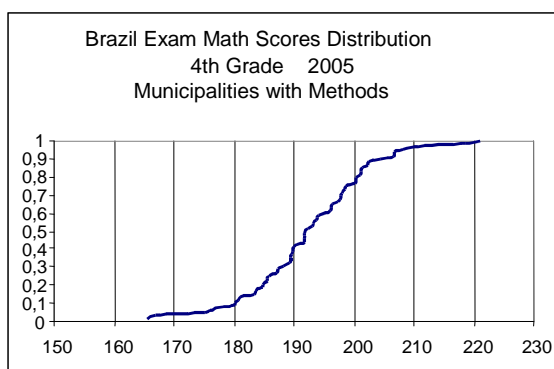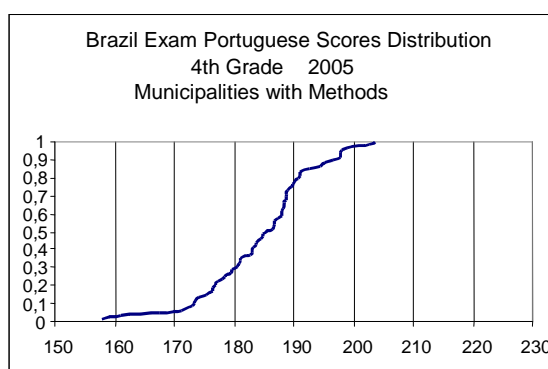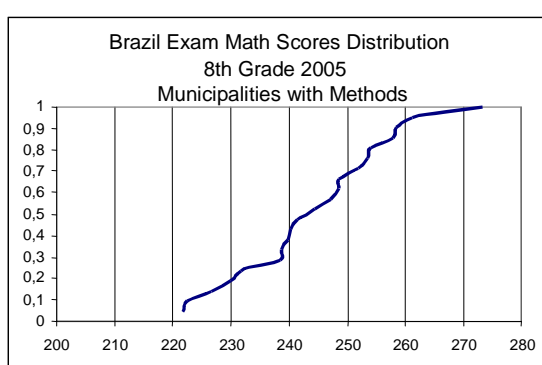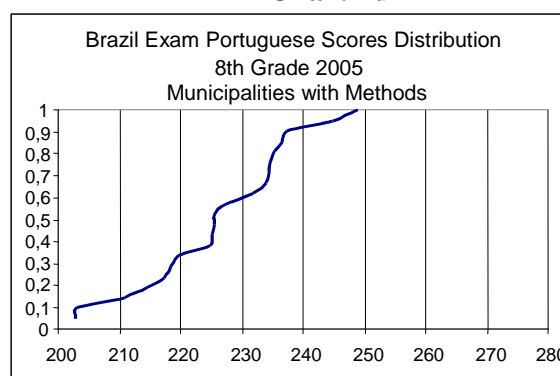
Table 10: Estimation of Structured Methods' Impact Interacted with 2005 Proficiency

Municipal Fixed Effect Regression: Expanded Sample

	4th Grade		8th Grade	
	Math Proficiency	**Portuguese Proficiency**	**Math Proficiency**	**Portuguese Proficiency**
Structured method	3.386	68.541**	155.476***	82.830*
	(38.795)	(30.024)	(48.202)	(44.994)
Structured method x BE 2005	0.007	-0.353**	-0.611***	-0.344*
	(0.201)	(0.162)	(0.197)	(0.198)
2007	12.679***	0.569	3.058**	6.955***
	(0.888)	(0.628)	(1.187)	(1.108)
Constant	194.802***	185.738***	247.365***	229.302***
	(0.579)	(0.409)	(0.759)	(0.709)
No.	782	782	239	239

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Standard deviations in parentheses.

We find that the break-even score – that is, the Prova Brasil exam score for which the marginal effect is zero – is 194.2 points (4th Grade, Portuguese). Chart 2.b shows that 86 percent of municipalities with structured methods score below this threshold. For 8th Grade Math, the score is 254.46 and covers 81 percent of municipalities, as seen in Chart 2c. Finally, for 8th Grade Portuguese, the score is 240.75 points and, again, as Chart 2d shows, 81 percent of municipalities with structured methods score below this level.

Chart 2a

Brazil Exam Math Scores Distribution
4th Grade   2005
Municipalities with Methods

Chart 2b

Brazil Exam Portuguese Scores Distribution
4th Grade   2005
Municipalities with Methods

Chart 2c

Brazil Exam Math Scores Distribution
8th Grade 2005
Municipalities with Methods

Chart 2d

Brazil Exam Portuguese Scores Distribution
8th Grade 2005
Municipalities with Methods

Restricting the sample does not change the results qualitatively, as it can be sen in Table 11 below.

Table 11: Estimation of Structured Methods' Effect Interacted with 2005 Proficiency - Municipal Fixed Effect Regression: Restricted Sample

	4th Grade		8th Grade	
	Math Proficiency	**Portuguese Proficiency**	**Math Proficiency**	**Portuguese Proficiency**
Structured method	4.131	70.228**	149.877***	56.923
	(40.512)	(31.138)	(56.690)	(55.078)
Structured method x BE 2005	0.006	-0.362**	-0.578**	-0.227
	(0.209)	(0.168)	(0.231)	(0.242)
2007	12.679***	0.569	3.058**	6.955***
	(0.890)	(0.630)	(1.199)	(1.126)
Constant	194.860***	185.781***	247.564***	229.559***
	(0.584)	(0.413)	(0.787)	(0.739)
Observations	772	772	227	227

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

Standard deviations in parentheses.

VI.3. The Effect of Accumulated Exposure to Structured Methods

This section investigates the impact of exposure years to structured methods on student proficiency. We attempt to determine the existence of cumulative effects of student exposure to structured methods over time. To this end, the control group becomes the set of all municipalities without methods by 2007, and we build two alternative treatment groups. The first one contains municipalities whose contracts started in 2005. For these, 4th graders had only been exposed to structured methods for one year at the time of the 2005 Prova Brasil exam. The exposure increases to 3 years at the time of the 2007 Prova Brasil exam. We label these groups 3 years vs. 1 year. The second group is made up of municipalities that adopted methods in 2004 and whose 4th graders had therefore had two years' exposure at 2005 Prova Brasil exam and 4 years' at the 2007 Prova Brasil exam. This group is labeled 4 years vs. 2 years. Table 12 shows the number of municipalities in each group, obtained only from the expanded sample and 4th graders.

Table 12 Number of municipalities

	Total	com BE
3 vs. 1	36	29
4 vs. 2	21	19
Control	169	130

The effect was estimated with the difference-in-differences method and controlling for municipal fixed effect. The treatment group's different results in 2007 and 2005 are due to two factors: duration of the exposure to the method and the time effect itself. Assuming that the time effect is the same for the treatment and control groups, our estimator identified the exposure effect. The estimation with the first group – 3 years vs. 1 year – identifies the effect of exposure from the 2nd to the 4th grade relative to exposure in the 4th grade only. The estimation done with the second treatment group – 4 years vs. 2 years – indicates the effect of 1st-4th grade exposure relative to 3rd-4th grade exposure.

The results can be seen in Table 13, next, and are qualitatively similar. The gain in Math scores is 4.6 points for the first group, 3 vs. 1, and 5.5 points for the second one, 4 vs. 2. Results for Portuguese are 1.61 for group 3 vs. 1 and 2.25 for 4 vs. 2; the results, however, are not statistically different from zero.

**Table 13: Estimation of the Effect of Accumulated Exposure to Structured Methods -
Municipal Fixed Effect Regression: 4th Grade**

	3 years vs. 1 year		4 years vs. 2 year	
	Math Proficiency	**Portuguese Proficiency**	**Math Proficiency**	**Portuguese Proficiency**
Structured method	4.595**	1.615	5.515***	2.248
	(1.905)	(1.372)	(2.163)	(1.527)
Constant	12.679***	0.569	12.679***	0.569
	(0.540)	(0.389)	(0.503)	(0.355)
Observations	1.083	1.083	1.053	1.053

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

Standard deviations in parentheses.

Taken together, the evidence indicates that exposure over time generates gains in Math scores. Note that this exercise is with respect only to differences between different exposures to the method between the 1st and 4th grades.

VII. Robustness Tests

The evidence so far indicates that municipalities adopting structured methods show some proficiency gains. This result, however, is not sufficient to credit the gains to the methods themselves, as it may reflect other characteristics that are correlated with method adoptions but not necessarily due to them. For example, the municipalities that contracted out structured methods may have specific socio-cultural characteristics associated with both proficiency gains and the adoption of structured methods. In that case, assigning the entire observed gain to the methods would over-estimate their effect. Strictly speaking, any omitted variable that is simultaneously associated with proficiency changes and adoption would bias the difference-in-differences estimators. To test for the possibility that an omitted variable is influencing our results, we run three robustness tests as described next.

VII.1. Results for the State System

Municipality's general and specific characteristics, preferences, local social norms, etc, may be associated with proficiency changes and the adoption of structured methods. Assuming that these general characteristics are mainly responsible for proficiency changes in the treatment group, they should also affect changes in the state schools found in the treatment group's municipalities. Therefore, the first test restricts the analysis to municipalities with both local and state schools, and compares the Prova Brasil scores achieved by schools in the state system at municipalities adopting structured methods in 2006-2007 with in the state system of municipalities without structured methods by that time. Because state system schools are not exposed to the structured methods, comparison of their results with those of the municipal systems – which are exposed to methods – helps interpret the results. Therefore, if the estimator for the variable that captures whether the municipality that adopts structured methods

for the schools in the municipal system is positive and significant for the municipal system only, and not for the schools in the state system, the results will favor the hypothesis of a positive causal impact of structured methods. If the estimator is positive and significant for schools in both systems, the result will indicate that the change is affected by a unobservable characteristics that impact both. This analysis is done on a sub-sample of municipalities that have both state and municipal schools.

As Table 14 shows, proficiency gains for state schools in municipalities that adopted structured methods do not differ from those of state schools in non-structured method municipalities. More specifically, the estimated changes are negative, even if not statistically different from zero. This result suggests that there is no omitted variable bias.

Table 14: Robustness Test with State Schools as Treatment – Municipal Fixed Effect Regression: 4th Grade

	State Schools		Municipal Schools	
	Math Proficiency	**Portuguese Proficiency**	**Math Proficiency**	**Portuguese Proficiency**
Structured method	-0.214	-1.504	4.322	3.324*
	(3.071)	(2.813)	(2.635)	(1.879)
2007	6.301***	-6.081***	13.069***	0.598
	(0.869)	(0.796)	(1.642)	(1.171)
Constant	190.525***	185.155***	193.472***	185.722***
	(0.557)	(0.510)	(0.916)	(0.653)
Observations	275	275	349	349

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Standard deviation in parentheses.

However, we also compared the results for municipal school only. The results are not statistically significant for Math and significant for Portuguese only at 10 percent. This result suggests that the no effect result found may be due to the smaller sample size. Thus, strictly speaking, the results are inconclusive, although it may suggest that unobserved municipal characteristics are not the only relevant factors at play.

VII.2. Results for 8th Graders in Municipalities with Structured Methods; Sample Restricted to Municipalities without Methods for Grades 5-8

Like the previous one, this exercise attempts to find indirect evidence of unobserved characteristics of municipalities and municipal education systems associated with proficiency changes and the adoption of structured methods. In this case, we compare the proficiency of 8th graders in municipalities that adopted methods up to the 4th grade with the proficiency of 8th graders in municipalities with no methods. The

hypothesis is that no student in either group is exposed to structured methods, but one group is exposed to unobserved characteristics closely associated with the adoption of structured methods.

Therefore, the second test restricts the treatment group to municipalities adopting structured methods in 2006 and 2007, with the exclusion of those with methods for the 5th to 8th grades. The control group is made up of municipalities with no structured methods by 2007. The difference-in-differences is estimated for 8th grade Math and Portuguese Prova Brasil exam scores and compared with 4th grade results. Therefore, a positive and significant 4th grade estimator along with a non-significant 8th grade estimator supports the hypothesis of positive causal impact of structured methods. A positive and significant estimator for both grades supports the hypothesis of self-selection bias.[4]

Table 15: Robustness Test Using the 8th Grade as Treatment
Municipal Fixed Effect Regression: municipalities with structured methods for grades 1-4

| | 8th Grade | | 4th Grade | |
	Math Proficiency	Portuguese Proficiency	Math Proficiency	Portuguese Proficiency
Structured method	-1.522	2.111	3.998	3.114
	(5.073)	(4.911)	(3.077)	(2.232)
2007	5.032***	8.346***	13.683***	0.972
	(1.058)	(1.024)	(0.831)	(0.603)
Constant	247.816***	228.950***	195.641***	186.706***
	(0.873)	(0.845)	(0.614)	(0.445)
Observations	350	350	987	987

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Standard deviations in parentheses.

As Table 15 shows, the effects on 8th Grade Prova Brasil exam scores are not statistically different from zero. Results are not statistically significant for the 4th Grade either, although the estimated scores are similar to those seen in the general estimation. Again, the absence of significance may be due to the sample's small size, thus the results are inconclusive.

VII.3. Results for Municipalities Adopting Methods in 2008

The final robustness test attempts to investigate whether a selection bias exists in the adoption of structured methods. To this end, we use a control group made up of municipalities that adopted methods in 2008 and that, as a result, had not been exposed at the time of the 2005 and 2007 Prova Brasil exams. Again, the control group is made up of municipalities that did not have methods in place by 2008. The results shown in

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[4]   On the other hand, the possibility of spillover cannot be dismissed.

Table 16 indicate that these municipalities showed greater performance gains in 4th Grade Math and Portuguese scores than the control group. Also, this group's score gain was far superior to that shown by the group made up of municipalities that did in fact adopt methods in 2006-2007. In other words, municipalities that decided to enter into agreements with private teaching systems in 2008 show the greatest proficiency gains in 2005 and 2007. This suggests a strong selection bias, at least for this group.

Table 16: Robustness Test Using 2008 Adopters as Treatment Group
Municipal Fixed Effect Regression: Municipalities with Structured Method only in 2008

	4th Grade	
	Math Proficiency	**Portuguese Proficiency**
Structured method	9.314**	8.503***
	(4.561)	(3.194)
2007	12.314***	0.236
	(0.903)	(0.632)
Constant	194.938***	185.787***
	(0.639)	(0.448)
Observations	723	723

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

Standard deviation in parentheses.

VIII. Conclusion

This study attempts to assess the impact of the adoption of structured methods private teaching systems offer to São Paulo State municipal administrations. The evidence suggests three main conclusions: (i) municipalities that adopt structured methods show greater proficiency in Math and Portuguese in the 4th and 8th grades than those without such adoptions in 2005 and 2007; (ii) municipalities that adopted structured methods in 2006 or 2007 show greater proficiency gains from 2005 to 2007 than those that did not adopt such methods; and (iii) the worst-performing municipalities in proficiency exams – with the exception of 4th grade Math – are those with the greatest gains from adopting structured methods.

However, robustness tests suggest that these results may not be necessarily due to the use of structured methods. One cannot rule out the possibility that unobserved municipal characteristics associated with proficiency changes over time may affect the results, even when we control for municipal fixed effects.

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