



The Peruvian teacher in-service training program and its effects on student achievement

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TIER WORKING PAPER SERIES
TIER WP 17/14

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This version: August 20, 2017

Abstract

This paper assesses the impact of the Peruvian Ministry of Education teacher in-service training program (henceforth the program) on student achievement. Given the importance the Ministry attaches to interventions to strengthen teaching practices since 2008, it is relevant to know whether its impact supports a wider application to public schools nationwide. Using annual data from the Student Evaluation Census-ECE- and from other official datasets for 2014, and a matching technique (Propensity Score Matching) to control for differences between beneficiaries, we estimate the impact of the program on students Math & Reading comprehension both for full-grade and multigrade schools. Results show that there is a positive and significant effect of the teacher training program on both Math and Reading achievement, but the magnitude of the effect differs. We find larger effects on Reading comprehension than on Math and in both topics larger effects for full-grade schools than for multigrade ones (the last are mostly found in rural areas). This might be related to the characteristics of the training in Reading comprehension: it is focused on learning pedagogical techniques (e.g. how to develop the curriculum within the classroom, how to motivate students, etc) instead of content knowledge, more focused on explaining mathematical problems. A sensitivity analysis complements and supports the results.

This paper also assesses whether the program is cost-effective. Comparisons with different programs, all of them related with the educational sector in Peru make us believe that it is worth implementing the program at a national level.

Keywords: Impact evaluation; Propensity Score Matching; Professional development; in-service teachers training; student achievement; cost-effectiveness.

1 Introduction

The large difference in enrollment rates and learning outcomes of students are seen as a huge problem in Peru. While the education enrollment at primary and secondary levels reached 99% and 92%, respectively in 2014, in the same year, according to the ECE,¹ 3 out of 5 second grade students did not reach a satisfactory level in Reading comprehension and 4 out of 5 in Math. This situation is even more serious if we consider the increasing gap between urban and rural students for both Reading comprehension (49.7% vs 16.7% reaching a satisfactory level) and Math (28.9% vs 13.1%).

In this context, the Peruvian government in 2008 established an educational policy which includes implementing the budget based on a theoretical model of problem identification and solution-based alternatives. Thus, inspired by the educational production function approach developed by Hanushek (1971) and Glewwe & Kremmer (2006), the government took action on the supply variables that are its direct responsibility: infrastructure, teachers professional development, educational materials and monitoring & evaluation. The Learning achievement for basic educational students Program (PELA), is a strategy that includes 5 areas of intervention related with these variables and for 2015 includes 46% of the education budget in Peru. (Ministry of Economics (2015)).

There have been several assessments on the impacts of PELA and the various programs that comprise it. Studies like Sanz (2012) on the national program of educational infrastructure and Benavides, Diaz & Villaran (2009) on the distribution of educational materials find a positive impact on the performance indicators of the programs (% of budget executed, % of correctly distributed materials) but a lack of information about the impact of such programs on student performance. In the teacher training program, so far there have been only qualitative studies about the programs organization (Rodriguez, Sanz & Soltau, 2013) that gives us information about the delivery of training but nothing about the effects on Math and Reading comprehension achievement.

Hence, this papers objective is to assess the impact of the teachers in-service professional development program on second grade students achievement in Math and Reading comprehension on multigrade and full-grade public schools. While full-grade schools are those where students and classrooms are divided by age and grade, multigrade schools refer to the ones where students of different ages and grades are grouped in a single classroom (usually located in rural environments). The reason for using second grade results is because the Peruvian Ministry of Education has been collecting them annually since 2007 by the ECE and has now a large data set that is very useful to evaluate achievement results of students.

¹The Census student assessment (ECE, by its acronym in Spanish) is a nationwide evaluation conducted annually by the Ministry of Education. Its purpose is to obtain information on the performance on Math and Reading of second-grade students in primary school and fourth-graders students in schools working under the IBE- Intercultural Bilingual Education modality).

The teacher training program focuses on a combination of personal classroom-based coaching plus workshops and conferences, which is part of PELAs and has been carried out by the Peruvian Ministry of Education since 2008 with various changes. The program supports kindergarten and primary public schools teachers, especially the ones that work in vulnerable schools (i.e. that are located in rural areas). (Rodriguez et al. (2013)). By using government data from 2014 and a matching technique- propensity score matching- to account for differences in enrollment of the program, we expect to find a positive impact of the program on students achievement, controlling for characteristics of the students environment (like rurality, poverty, nutrition level). Results will add to the empirical evidence that has been collected in recent years.

This paper will also assess if the intervention is cost-effective, in order to recommend educational policy measures based on the analysis.

The relevance of this study is found in the increasing importance that this teacher training program has within educational policy in Peru. It is especially seen as a way to improve students results in multigrade schools, where the national results shows a difference of almost 30 percentage points with respect to full-grade schools in Reading comprehension and 16 p.p. in Math (ECE results 2014). Results of the research may shed light on the effectiveness of the intervention and whether it is a good decision to increase the scale of the program to the national level. Additionally, the results can add to the international literature about the impact of this kind of professional development programs focused on the training of teachers (in-service programs) as a way to improve their abilities, especially when they work in underdeveloped environments. This paper is structured as follows: Section 2 describes the theoretical framework of the program; it includes the description of the Peruvian program and its results in terms of outcomes. Special attention is given to the targeting criteria for the selection of the beneficiaries, as this is important to link the intervention with the paper methodological framework.

Section 3 describes the methodology for the estimation of the impact of the in-service program on student achievement. A discussion about the reason to choose Propensity Score Matching as an appropriate methodology to estimate the impact of the program is explained here. Section 4 shows the empirical results of the impact evaluation estimations, including a robustness check and a sensibility analysis of them.

Finally, Section 5 develops a cost-effectiveness analysis of the results by comparing it with other educational programs implemented in Peru to answer the question about the relevance of scaling it up to the national level. It finishes with some concluding remarks and a discussion of the main findings.

2 Teachers' Professional Development program

2.1 Theoretical framework

In this section we describe the theoretical framework of the program, a special professional development program intended to improve teachers abilities to teach students in vulnerable conditions. We start by linking the intervention with the theory of professional development and then describe the specific features of the Peruvian program, in order to obtain insight on the outcomes that have been obtained during the last years.

Professional Development refers to a systematic process of teacher training intended to improve their knowledge by the use of instructional strategies whose final objective is to improve the development of teachers in the classroom (Glatthorn (1995), No Child Left behind Act of 2001)). This process, intended to enhance teachers knowledge and to impact on student achievement has been widely studied. Yoon et al. (2008) using previous research done by Kennedy, (1998), Cohen & Hill, (2000), Garet et al, (2001) and Guskey & Sparks, (2004), argue that the impact of teacher training on student performance is mediated by how teachers process this new knowledge and their ability to deliver the acquired techniques to their students.

Despite the last, its less clear how these programs must be developed to have more impact on student achievement. According to authors like Unal, Demir & Kilic, (2011), Kennedy (1998), Clewell, Campbell, and Perlman (2004), Yoon et al (2008) and the No Child Left behind Act of 2001, this kind of programs must be intensive, content-focused, sustained for a longer period of time and aligned with student achievement standards to improve learning outcomes.

Additionally, effects differ by the type of support, duration, income level of beneficiaries and the focus of the intervention. Systematic reviews by Yoon et al (2008), Bando & Li (2014) and Carrillo et al (2016) show that, as expected, the duration of the training program has a positive impact. The same holds for the income level of beneficiaries: programs delivered to poor and rural schools have more impact than the ones delivered in urban or more developed areas. Finally, a greater impact is observed in courses like Math when the training is more focused on giving instructional (content-focused) training rather than training pedagogical techniques to teachers. The contrary holds for Reading comprehension.

However, there is some conflicting evidence about the impact of these programs on student achievement. Jacob & Lefgren (2004) detail how Kennedys study only shows a positive impact in 12 of the 93 studies, which downplays the results found by his study and contradicts the conclusions in Yoon et al (2008) and Cohen & Hill, (2000). The latter, in addition to the lack of evidence on the impact of professional development programs in developing countries, raises questions about the expected impact of this kind of training and warrants doing more research, especially in the case of an intervention of the magnitude like the teacher training program in Peru.

To understand the Peruvian governments decision it is necessary to describe previous experi-

ences with the teachers in-service programs that have served as a reference for this program. The APRENDES program was a very limited in-service program implemented in two isolated Peruvian Regions (San Martin and Ucayali) between 2003-2009 with a program that included periodic workshops, classroom-based coaching, teachers meetings to share experiences and visits to similar schools. Focused on multigrade primary schools, the program benefitted more than 16.577 students and 811 teachers. An assessment conducted between 2004 and 2008 showed positive effects on students in first, third and sixth grade in Reading comprehension and Math. (Bernhaum et al. (2010)).

Another experience named PROMEB was carried out in Piura-Peru during 2003. Funded by the Canadian International Development Agency (ACDI), it included personalized support to teachers and principals of selected schools. Alcazar and Guerrero (2011) found positive effects on students Reading comprehension. In both programs interventions were basically focused on giving continuous training to teachers about pedagogical techniques to improve their teaching practices. Elsewhere in Latin American similar experiences are found with the Ecuadorian Si Profe program. This one, introduced in 2012, includes an annual educational support of 48 hours (8 sessions of 6 hours each) on topics mainly related with improving learning methodologies, pedagogical leadership, and teacher feedback. (McCollum et al (2011)).

2.2 Description and implementation of the Peruvian teacher in-service training program

The program can be described as in-service training. This is a specific kind of professional development focused on a combination of personal classroom-based coaching plus some additional work in the form of workshops and conferences. This structured program intends to give teachers new skills and technical feedback about better teaching practices (Lazarova & Prokopova, (2004) and Harvey, S. (1999)).

The program is part of the PELA national program established in 2008, whose objective is to improve the learning achievements of students from 3 to 16 years old, covering almost the entire period of Elementary School in the public system.² Even though the PELA program covers the entire public school population, the intervention gives special attention to teachers and students located in rural areas and those who are in a situation of vulnerability (in some of this locations only 1 out of 5 teachers obtained a satisfactory level in an independent evaluation of their teaching abilities (Rodriguez et al. (2013)). The PELAs program has five areas of intervention: improving educational infrastructure, teachers development, delivery of educational materials, monitoring &

²PELA incorporates six of the seven cycles of Elementary School in order to articulate the educational processes at different levels. The II cycle includes the children between 3 and 5 years old who assist to a educational institution (schooled or unschooled); the III, IV and V cycles proportionally divide the six grades of elementary school and incorporates students from 6- 11 years old; finally, the VI and VII cycle of Elementary School divide the five years of secondary which includes students from 12 to 16 years.

evaluation of educational quality, and (since 2016) evaluation of principals & teachers (Ministry of Education, 2015).

Within the PELA strategy, the second intervention, related to teachers development, is the one that includes a set of interventions intended to improve the capabilities of teachers in the classroom. It includes 4 types of interventions to teachers (Ministry of Education 2015):

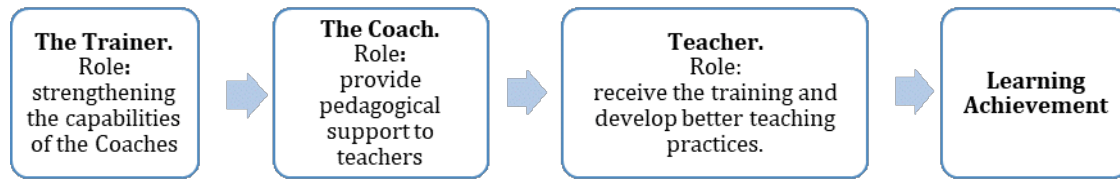
- Curriculum management, aimed at preparing teachers for a better implementation of the curriculum within the classroom
- Teacher specialization, which updates programs in Reading comprehension, Math, English as a second language and other subjects for teachers. Includes specialization in kindergarten as well.
- Strengthening of underperforming students, a set of strategies aimed to develop Math and Reading comprehension skills of elementary students (since 2016).
- Teacher in-service training for regular and bilingual education.

The objective of the in-service training program is to improve teaching practices and management through feedback and continuous support from other teachers who work as coaches. (Rodriguez et al. (2013)). The program accounts for the different types of schools that coexist in Peru: i) multigrade primary schools for students of different grades and ages, ii) full grade schools for students of different grade and ages and iii) bilingual schools where students speak their native language. The focus of the research is on the first two groups (multigrade and full grade schools).

About the sequence of the training, as stated in Figure 1, the program starts with Trainers, a group of specialized personnel in charge of a territorial circumscription, responsible for training the coaches and provides them with technical pedagogical assistance. Each trainer is in charge of 15 coaches in the case of full grade schools and 12 coaches in multigrade and they make one visit a month to both types of schools (Ministry of Education (2012)). After the first year of implementation, where the Trainer selection made by Regional governments resulted in differences in quality, the Ministry of Education decided to manage these contracts in order to have a similar baseline for all Trainers, leaving it to the regional government to organize the financing, selection, execution and monitoring of the coaches.³ The selected coaches also received three workshops per year with a duration of 6 days in full grade schools and 5 days in multigrade schools.

³For being a coach its necessary to be trained at least 140 hours a year (with distance training of about 220 additional hours). Training includes a certification on adult learning methodologies or educational support in the educational level where they are working.

Figure 1: Training sequence to achieve learning outcomes



Notes: Based on the update reports of the PELA 2013- 2016.

The process continues with the training of teachers by coaches. Here, the program is based on a systematic approach (which lasts three years) containing 4 steps that have to be completed by each teacher to be considered as fully trained: classroom visits, micro workshops, update workshops, internship and virtual training (Ministry of Education (2015)). The duration of each component differs between multigrade and full grade schools as described in Table 1.

According to SIGMA data, in 2015 full grade school teachers received on average 100% of the classroom visits planned, 98% in the case of micro workshops and 62% for update workshops. Multigrade school teachers received on average 98% of the classroom visits planned, 100% of the micro workshops and 65% of update workshops.

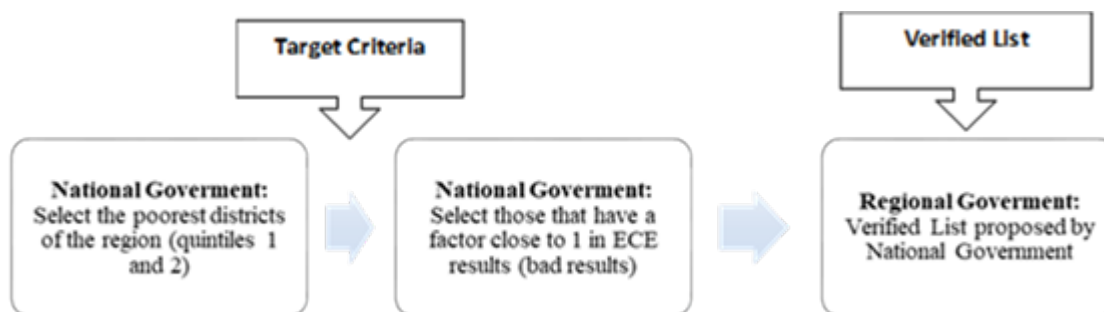
Additionally, the number of treated teachers was 23,668 (14% of all public sector teachers in primary and initial education) and 11,176 schools were covered (49% of the total number of public schools in primary and initial education). These numbers yield sufficient data to estimate the impact of the program.

Finally, as stated by Rodriguez et al. (2013) and Ministry of Education, (2015) the decision where to allocate the trainings -prioritization- has changed during the last years. During the period 2008-2012 priority was given to urban schools. Since 2013 the focus has shifted to rural and bilingual institutions. This was based on the following criteria:

1. Equity: schools located in districts with high and extreme poverty (Quintiles 1&2).
2. Student achievement: districts having low levels on learning achievement on the Student Evaluation Census for the past periods.
3. Multigrade schools: multigrade, monolingual and bilingual schools.

So, first the Ministry of Education selects the potential schools that are included in the training program considering the above-mentioned criteria. Next, Regional governments together with the Local Education Management Office (UGEL) verify this information and check the availability of funds considering their annual budget (See Figure 2).

Figure 2: Training sequence to achieve learning outcomes



Notes: Based on the update reports of the PELA 2013- 2016.

Table 1: In service training program components

Components	Description	Frequency	
		Full grade schools	Multigrade schools
Classroom visits	Sequence of visits during class hours.	7 visits (5 hours per visit)	09 visits (5 hours per visit)
Micro workshops	Concerted meetings of mutual learning between the coaches and teachers in order to enhance their learning from the experience of their peers.	08 (4 hours per workshop)	07 (2 hours per workshop)
Update workshops	Directed by specialized teachers' in order to update other teachers knowledge with validated instructional strategies and the use of tools and materials.	03 by year (40 hours per workshop)	03 by year (40 hours per workshop)
Internships	Full-day observation of a different classroom	01 by year	01 by year
Virtual training	Virtual interaction between the teacher and specialists of the Ministry of Education to answer question in the process	Continuous	Continuous

Notes: Based on the update reports of the PELA 2013- 2016.

3 Methodological Framework

3.1 Base Data Source

The main data bases used in this research are:

- The Census student assessment- ECE, which reports the results obtained in a test designed to assess the performance level in Reading comprehension and Math of children in the second grade of elementary school;
- The Information and management system for improving learning- SIGMA, which is a tool of the Ministry of Education in order to monitor and share information about the treated schools of the in-service program; and
- The Ministry of Inclusion Poverty Map, that considers information about poverty, rurality and malnutrition of the territory at a district level.

ECE uses a Rasch model that measures the student's ability and assigns a score depending on how the student answer the questions of the test. The scores are classified in three levels of achievement: i) beginner level, which means that the student does not achieve the expected level of learning, and struggles to answer the easiest questions of the evaluation; ii) in progress level, where student does not achieve results expected for the grade but is in the process to do it; and iii) satisfactory level, which means that the students achieved the results expected for the grade (PELA reports). The ECE contains variables related to student achievement (students score), school characteristics (level of enrollment, geography, full grade or multigrade schools) and information about other public programs that intervene on the school (like CRECER which is a nutrition program or JUNTOS which is a cash transfer program).

SIGMA allows us to identify schools in which teachers received the training program. The variables available in this database are: geographic area, management of school, teachers experience, progress of the visits (coaching sessions) and progress of the workshops, aspects that are all part of the program.

In the following table we present the relevant variables of the study, the source of information and how they are included in the model.

Table 2: Descriptive statistics

	Variables	Data Base Source	Description	Level
Y_{it}	Student Achievement	ECE	Score	Student-school
X_{it}	Schools' treated	SIGMA	Dummy	Schools
Z_1	Rural	ECE	Dummy	District
Z_2	Multigrade school	ECE	Dummy	Schools
Z_3	Full grade school	ECE	Dummy	School
Z_4	Poverty (district level)	Inclusion Ministry Poor Map	Percentage of poor people	District
Z_5	Malnutrition (district level)	Inclusion Ministry Poor Map	Percentage of malnutrition people	District
Z_6	CRECER (Nutrition program)	National Evaluation Census	Dummy	School
Z_7	JUNTOS (Cash transfer program)	National Evaluation Census	Dummy	School

3.1.1 Different characteristics between schools

Using the data described above it is possible to define the treated sample as the public schools with teachers who receive the in-service training and the control group as public schools who did not. As observed in Table 3, the comparison of the means of the control variables (rurality, poverty, extreme poverty, malnutrition and multigrade) between both samples reject the null hypothesis of equality so we can say that both samples are statically different. This means that we need to apply an appropriate statistical technique to match samples and ensure comparability within the evaluation.

Table 3: Sample characteristics

	Treatment (n=4,389)		Control Group (n=25,002)		Mean Comparison
	Mean	Std dv	Mean	Std dv	P-Value
Output Variable					
Reading score	416.99	148.72	416.25	156.53	0.7720
Math score	498.14	72.74	498.42	69.72	0.8056
Control Variables					
Rurality	0.90	0.29	0.71	0.45	0.0000
Poverty	0.60	0.22	0.54	0.23	0.0000
Extreme Poverty	0.30	0.19	0.24	0.18	0.0000
Malnutrition	40.26	15.96	35.63	15.69	0.0000
Multiple teacher multigrade	0.56	0.49	0.39	0.49	0.0000

3.2 Implementation of Propensity Score Matching

The Propensity Score Matching (PSM) methodology creates the control group by modeling the probability of participation in the program on the basis of the observed characteristics of the schools. Two assumptions are necessary to guarantee a good estimation: Conditional Independence and Common Support (Rosenbaum and Rubin, 1983). The first one implies that the program is based on observable characteristics; and the second, ensures that treatment observations have comparison observations in the propensity score distribution.

In the case of the program, conditional independence is achieved because selection of the treated schools depends mainly on observable characteristics such as the poverty level of the districts and rurality.⁴ On the other hand, common support is obtained if the P-score of the observable variables within the Probit model are positive and significant.

For the purpose of this research we use both the Nearest Neighbor Matching (NNM) and Radius Caliper Matching (RCM) algorithms, preferring the last one because it imposes a tolerance level on the maximum propensity score distance, caliper, which is relevant when the distribution is very different between the two samples. The caliper we are going to use on this research, as stated in Smith and Todd (2005), is 0.01.

⁴We assume the unobservable characteristics used by Regional and Local governments to select benefited schools, like budget constraints or other selection criteria, wont have an impact on the final allocation of the training.

4 Results of the Propensity Score Matching

With the PSM technique we estimate the impact of the program. As stated before, we differentiate the sample between multigrade and full grade schools considering that the program may have different interventions for both groups of schools. The steps of the analysis are described below.

4.1 Estimating the P-score matching for multigrade and full grade samples

We estimated the p-score matching of each school with a probit model:

$$D_i = \beta_0 + \beta_1 rursality_i + \beta_2 extreme\ poverty_i + \beta_3 malnutrition_i + \beta_4 JUNTOS_i + \beta_5 VRAEM_i + \varepsilon_i,$$

Where D is the variable selection that takes the value of 1 when the school is treated (i.e. teachers receive the training) and 0 in the other case, β_0 is the constant parameter of the model, β_1 is the parameter of the effect of rurality on the treatment selection, β_2 the poverty parameter, β_3 the effect of malnutrition, β_4 the parameters who controls the effect of other program, and β_5 show if the schools is located in the VRAEM vulnerable area.⁵

Results are shown in Tables 4 for multigrade and full grade sample. For the multigrade sample, all the control variables are statistically significant except for the rurality coefficient, which can be explained because most of the multigrade schools are rural so there is not a lot of variance in this variable. In the case of full grade schools, almost all variables are statistically significant. Here rurality is statistically significant, which is expected because we find full grade schools both in rural and in urban parts of the country.

⁵VRAEM is referred to a Peruvian remote territory involved with high levels of poverty, violence and illegal activities.

Table 4: Results of the probit estimation in full-grade and multigrade schools

Schools Management				
	Full-grade schools		Multigrade Schools	
Variable	Coefficient	Stv Error	Coefficient	Stv Error
Constant	-0.993***	0.045	-2.062***	0.058
Rurality	0.0057	0.040	0.503***	0.061
Extreme poverty	0.3435***	0.721	0.416**	0.219
Malnutrition	0.2009***	0.072	0.978***	0.155
JUNTOS	0.1919***	0.288	0.112	0.086
VRAEM	0.2941***	0.043	0.278**	0.127

Notes: ** significant at 5%, *** significant at 1%.

4.2 Matching and estimating results

The number of treatment and control schools after the matching is for multigrade schools 4,052 and 16,094, and for full grade schools 337 and 6,486, respectively.

The results of the matching show that the effect of the program for multigrade and full grade schools is positive and relevant for Math and Reading comprehension among second grade students achievement, using different matching strategies (one neighbor, multiple neighbor and radius caliper). In particular, we observe that the program has a greater impact in Reading comprehension than in Math, which can be explained by the specific characteristics of the program.

As observed in Table 5, using Radius Caliper the participation of a teacher increases his or her students achievement in Reading Comprehension by 0.148 standard deviation for multigrade schools and 0.233 for full grade schools; in Math effects are positive and show an increase in learning outcomes by 0.083 standard deviation for multigrade and 0.137 for full grade schools, all of them statistically significant.

These positive results are aligned to the ones obtained by the impact evaluations of similar interventions. Angrist and Lavy (2001) found that the training program in nonreligious Israeli schools increased students test scores by 0.25 standard deviation. Additionally, Yoon et al. (2008) for a group of 9 papers that meets the What Works Clearinghouse evidence standards found that the average effect size was 0.54 (in both Math and Reading) for teachers receiving the professional development programs.

Moreover, if we compare the results obtained between multigrade and full grade schools we find that the second one has more impact. This might be explained by the homogeneity of students. While in full grade schools all students will have the same age and level, in multigrade schools the teacher has to divide his time to teach different subjects within the same class, which is detrimental to the time spent on each student.

Table 5: Estimation results and robustness checks of training on Reading and Math scores

Estimation Results				
	Multigrade schools		Full grade schools	
Output^{1/}	Coefficient	Stdv. Error	Coefficient	Stdv. Error
Reading score	0.148***	0.018	0.233***	0.066
Math score	0.083***	0.018	0.137***	0.051

Robustness Analysis				
	Multigrade schools		Full grade schools	
Output^{1/}	Coefficient	Stdv. Error	Coefficient	Stdv. Error
Reading score	0.156***	0.023	0.198***	0.055
Math score	0.075***	0.021	0.120***	0.049

Notes: ** significant at 5%, *** significant at 1%. Multigrade sample (treated: 4,052; control group: 16,094) and full grade sample (treated: 337 ; control group: 6,486)

4.3 Robustness analysis

To obtain more certainty about the potential variance of the results, we analyze the robustness of the estimates, dropping the extreme values of the sample. We divide the sample in quintiles and we drop from the sample the first and last quintile. In table 5 we observe that the results are very similar to the ones obtained in the previous analysis: 0.156 SD on Reading comprehension and 0.075 SD on Math for multigrade schools and 0.198 SD on Reading comprehension and 0.120 SD on Math for full grade schools.

5 Discussion and Conclusion

Does the Peruvian teacher in-service program have a significant effect on students achievement is the main question of this research. Using a quasi-experimental propensity score matching design, we find positive and relevant effects of the teacher training program on student achievement in both on multigrade and full grade schools. These results are in line with other studies that have assessed the impact of in-service programs (Anderson (2000), Angrist & Lavy (2001), Saxe, Gearhart, & Nasir (2001), Glazerman et al.(2010), Telese (2012) and Rosangela Bando and Xia Li (2014)).

For policy implementation it is important to assess if the expenditure was worth it (i.e. is cost-effective) for full grade and mutigrade schools compared to other interventions in Peru with the same objective but with a different focus. This is important to find if it is recommendable to scale the intervention up as is planned in the future. So, a comparison with the Full school day program is made. This intervention has the objective to improve students results by increasing 10 lecture hours weekly in all secondary schools in Peru. On the intervention, implemented in 2015 in 1,602 schools with an investment of US\$ 906 per pupil, an impact evaluation was done by the Ministry of Education (2015), which showed a positive and significant impact on student achievement in Math and Reading comprehension of 0.233 SD and 0.185 SD, respectively.

So, in order to compare it with the teacher in-service program in multigrade and full grade schools we use information about the cost of the implementation of the program for each kind of school and compare it with the results from the Full day program. In the case of multigrade schools, the cost per pupil of the in-service teacher training program was US\$ 236 and considering the impacts on Math and Reading comprehension, we get that the cost per pupil to increase 0.1 standard deviation is US\$ 284 and US\$ 159 per pupil in Math and Reading comprehension, respectively. On other hand, for full grade schools, the cost per pupil of the program was US\$ 46 and considering its impacts on Math and Reading comprehension, the cost per pupil for an increase of 0.1 standard deviation is US\$ 33 and US\$ 19 in Math and Reading comprehension, respectively.

Results in Table 6 show that the teacher in-service training program (both in multigrade and full grade schools) is more cost-effective than the Full school day, what means that government may consider upscaling the in-service program as a way to improve students results before lengthening school hours, as this appears to be a more efficient education policy.

Table 6: Cost Effective analysis

Intervention	Effect	Cost	Cost-effectiveness ratio
	Average test score	Cost per student (dollars)	Cost per student per 0.1 SD gain (dollars)
Math			
Teachers in-service program (multigrade schools)	0.083	236	284
Teachers in-service program (Full grade schools)	0.137	45	33
Lengthening the schools hours (Full school day)	0.233	906	389
Reading Comprehension			
Teachers in-service program (multigrade schools)	0.148	236	159
Teachers in-service program (Full grade schools)	0.233	45	19
Lengthening the schools hours (Full school day)	0.185	906	490

Finally, it is important to consider further analysis about the differential impact of the duration of the program on student achievement. Until now results gave us the idea that a program like that in Peru, with a significant duration (between 2 and 3 years), adds to the positive results of the program, but it remains to be seen whether these effects on student achievement are maintained over time. Additionally, it is important to think about the differential impacts of the elements of the teachers program, (e.g. whether the use of workshops has any differential impact on the student achievement).

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TIER WP 17/14
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ISBN 978-94-003-0130-6