

Teacher Unionization and the Quality of Education in Peru: an Empirical Evaluation using Survey Data^(*)

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Summary: In this paper we analyse the evolution and current profile teacher unionization and estimate the impact of unionization on the quality of public education in Perú. The research uses data from a 1999 household survey (ENAHO) and from a recent evaluation of a public program oriented to improve the quality of Peruvian public education.

Regarding the evolution of unionization, we find evidence compatible with the hypothesis that the rate of teacher unionization has dropped during the last three decades, but especially during the 1990s, due basically to the hiring of temporary teachers.

With respect to the profile of unionization, we find that unionized teachers are older and more experienced, and that males are more common in the union membership. We did not find empirical evidence that unionized teachers enjoy better access to educational infrastructure at the *polidocente* (larger) schools, but that they do have better access at the *multigrado* (intermediate) schools.

For the impact of unionization on quality, we adapted Hoxby's production function model to the Peruvian case in which public education is centralized and in which teachers do not have major influence on the education budget at the school or district levels. We estimate the model to test if unionization has an impact on teachers' effort and student achievement and do not find empirical support for these hypotheses. The data indicate that unionization does not seem to be a major factor affecting the quality of educational services in the Peruvian public education system currently.

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Introduction

The Peruvian public education is characterized by high coverage (at developed country levels) but extremely low expenditures per student, which raises serious concerns regarding the quality of the educational services that Peruvian children are receiving. Recent efforts to face this problem by the Government of Peru have been oriented to increase public expenditures on education infrastructure, inputs and teachers' training, especially through a program focused on increasing the quality of education called MECEP (*Mejoramiento de la Calidad de la Educacion Peruana*). The program has increased inputs and training to teachers, although without significant changes in the institutional context in which the educational system works. There are concerns that the effectiveness of this policy may be limited due to adverse institutional factors.

One such important institutional factor is the presence of an important teachers' union (called SUTEP) in the Peruvian educational public sector. The union might play a role in the provision of educational services if it affects the allocation of public resources to education and/or the incentives their affiliates face to provide services. This research is oriented to evaluate empirically whether teacher unionism plays such a role in the Peruvian context.

There are no prior studies in Peru about the role of the teacher's union in the provision of education from an institutional and economic perspective. SUTEP is the only teacher's union in Peru and its affiliates are estimated at 145,000 teachers nationwide currently. The union was founded in the 1970s and has had an important role in the last three decades due to the mobilization of teachers, especially during the 1970s and 1980s. Its political clout and economic importance declined during the 1990s, although recently (2000-2001) it has started to increase its influence on policy based on the

controversial process of appointing temporary teachers by the Ministry of Education. The union is still one of the largest in the public sector in Peru. Questions about its effect on the quantity and quality of educational services remain as of clear importance for policy makers and researchers.

In particular, in this project we are interested in four specific questions related to the teachers' union: (i) how has the rate of teacher unionization evolved during the last three decades?, (ii) is the profile of unionized teachers different from the one of the non-unionized ones?, (iii) is there empirical evidence that teachers affiliated to SUTEP have better access to educational resources than non-unionized teachers?, (iv) is there empirical evidence that unionized teachers have a different (better or worse) performance in the provision of public educational services?.

Recent program evaluations and case studies have made available data which allows for an empirical treatment of these issues. A growing body of evaluations and studies have created a critical mass of information permitting a more rigorous exploration into which institutional and economic factors may affect the quality and provision of education services to Peruvian children (Instituto Apoyo a, b, and c). In particular, in this research we use data taken from a recent evaluation of the MECEP Program (Instituto Apoyo, d) and from a national household survey (ENAHO, 1999) in which there is a large sub-sample of teachers.

This paper is divided into the following five sections: **Section 1** describes the institutional context in which teacher unionization has taken place in Peru in the last three decades; **Section 2** analyzes questions about unionization evolution, union profile and differential access to educational infrastructure; **Sector 3** develops a model which will be used to answer the fourth question on performance based upon a production

function approach; **Section 4** describes the estimation results for the model and **Section 5** is devoted to conclusions.

Section 1: Unionization and the Peruvian Educational System

In contrast with the U.S. and other Latin American countries (Hoxby 1996), the public education system in Peru is fairly centralized and most if not all allocation decisions are made by a central authority, the Ministry of Education (MOE). Likewise, the teacher's union, *Sindicato Unico de Trabajadores de la Educacion del Perú* (SUTEP) is a consolidated and centralized body that seeks to influence both general policies as well as sector decisions. It was founded in 1973, a result of a merger of four autonomous unions. From that point on, it has been the sole teacher's union in Peru, with a current membership of about 145,000 teachers of the 265,000 officially existing public teachers at the national level.

Most analyst of the union agree that the union's influence on policy and salary bargaining reached its peak in the mid 1970s. In 1975-1977 the union organized one of the longest strikes against the military government. After 1977 about 10,000 teachers (especially those involved in union leadership) were laid off by the military government, seriously weakening the union's power. In those years a leftist Party called *Patria Roja* reached control over the union leadership, which it still holds today.

During the 1980s SUTEP concentrated its activities on organizing eventual national strikes which were less and less effective as the country's economic conditions deteriorated. In 1984 the union was finally recognized by the Belaúnde Government (1980-1985), after several years of union pressure and mobilizations.

In interviews with people related to the union, it was mentioned that unionization in the early years of SUTEP (1970s and early 1980s) was basically related to political

convictions of university students. In those years, young students in the education career were easily attracted to the leftist ideology of *Patria Roja* and later on--when graduated--became union members as an expected next step. A proposition which also called out attention was that the presence of SUTEP in rural areas was important due to the political work done by the main party behind the leadership. As representation in the union leadership is related to the number of political districts rather than to the number of students in schools (higher in urban sites), rural areas remain important for the party advocates and the union work.

Each year SUTEP approves a document called "*Pliego de Reclamos*" in which it lists all its demands to the Government in terms labor conditions, wage increases and educational goals, among other general political issues. The document has been losing importance over the years, but it is still one of the main tools that SUTEP leaders use in their union activities.

Other very important tool of union operation is the DERRAMA fund, a fund which is managed by the SUTEP Executive Committee and used to give some services (including loans) to union affiliates. The fund started with the confiscated salaries of teachers during the 1977 strike, and is also kept by monthly contributions by members. An important change to the institutional context of the Peruvian educational system was the approval, in 1990 at the end of the Alan Garcia Government, of a new law for teachers (*Ley del Profesorado*) which created a special status for teachers. After that law, it was stated that only those persons who have studied to be a teacher can be hired in the public sector, closing this option for other professionals. Also, according to this law, teachers in the public sector are public servants with full duties and privileges. A teacher who is tenured (i.e., which occupies a formal position in the public cadre of

personnel, CAP) has job security and social benefits when retiring. The approval of the Law is considered one of the important achievements of SUTEP since its foundation.

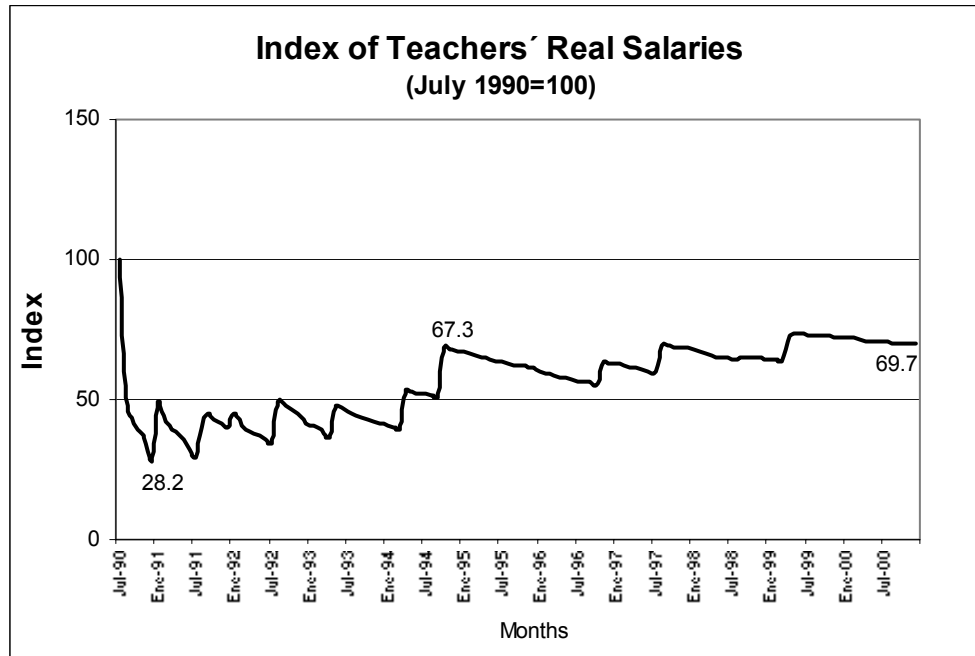
Since the impact of any salary adjustment for teachers on the public budget is generally very big, the last three governments (1980-85, 1985-90, 1990-2000) have been totally opposed to any significant increase in teachers wages in real terms. After the severe economic crisis of 1990 (in which inflation reached four digits), the new Fujimori Government froze the size of the educational CAP in order to avoid increasing pressure on the budget from the almost 40,000 retired teachers. However, the demand for teachers remained high in a country in which most of the population sends their children to public schools. Thus, after 1993, the authorities introduced an innovation in its labor relations, allowing the hiring of “temporary” teachers. Currently, it is estimated that about 25 percent of teachers have non-tenured status in the public sector¹. This dual structure for teachers is not linked to any significant wage differences (differentials are minimal; wages being equally low for all teachers). There is, however, an important distinction: non-tenured teachers do not enjoy job security and as a consequence can be fired at any moment without compensation in addition to not receiving any pension benefits. This is so because they are hired using a contract in which the non-tenured teacher is a sort of service provider without any of the considerations of a stable labor relationship. Clearly this option was used to avoid increasing pressure over social benefits among teachers while accommodating the increasing demand for them.

In the 1990s the SUTEP did not play a direct role regarding wage bargaining or even policy decisions. After the collapse of wages at the beginning of the 1990s, teachers’

¹ Recently the government of president Toledo has started a process of tenuring of temporary teachers based on an evaluation, which is still contested by SUTEP. The end-point of this process (probably 2003) may change in unexpected ways the specific weight of the union in the educational sector as tenured teachers are more likely to enroll in the union.

real wages could not recover during the whole decade under Fujimori's rule, and at the end of the decade these were a mere 70% of real wages in 1990 (Graph 1).

Graph 1



With teachers salaries at low levels, the Fujimori Government increased public investment in education. Since 1996 the Peruvian educational system enjoyed higher levels of investment, especially in inputs, training and infrastructure (basically through the MECEP program and the investment by FONCODES and INFES in school infrastructure). Although SUTEP did not play a significant role in these decisions, at least at the central level, it can have influenced the impacts on educational outputs. Because of the massive coverage and network structure of the union we cannot rule out that SUTEP plays a significant role on the efficiency of resource allocation, which is one of the topics that we explore in this research (third and fourth sections).

Other important avenues through which the union may play a role on the educational output is in the process of teachers allocation itself, for example among rural and urban areas, or among different types of schools. In general, according to interviewed experts, the process of allocation is not linked to performance or training, and teachers end up

assigned to rural and urban areas without major planning, evaluation and incentives by the MOE. In last years, temporary teachers are much more likely to be assigned to less favorably located schools in rural areas. It is plausible that SUTEP may have ways to influence this allocation process favoring unionized teachers (to better schools), and therefore affecting the final output of the education process. This result would be policy relevant if unionized teachers are really different in the provision of educational services, which is what we evaluate in the third and fourth sections later on.

Section 2: Unionization, teacher profile and access to educational infrastructure

2.1. Unionization in the public teacher career

We have two sources of data regarding the unionization status of teachers: (i) the 1999 ENAHO survey, which is a representative sample of all Peruvian households in which there is a sub-sample of 574 teachers, and (ii) the 2000 MECEP evaluation survey, which is based on a stratified sample of 700 schools nationwide with about 1400 teachers surveyed.

In Table 1 we relate teachers' experience to current unionization status in the 1999 ENAHO survey. The rate of unionization among the surveyed teachers is 45%. As can be seen, teachers with more experience are more likely to be unionized. The data also is compatible with a declining rate of unionization in the last three decades although for relating these figures to rates of unionization we need to accept assumptions like "exit rates and changes in union status among teachers do not have significant impacts on the average rate of unionization".

Table 1: Experience and Unionization

	Nº Teachers	Unionized	
Year became teacher			
less 1980	40	28	70%
1980-85	103	61	59%
1986-90	171	99	58%
1991-99	260	72	28%
Total	574	260	45%

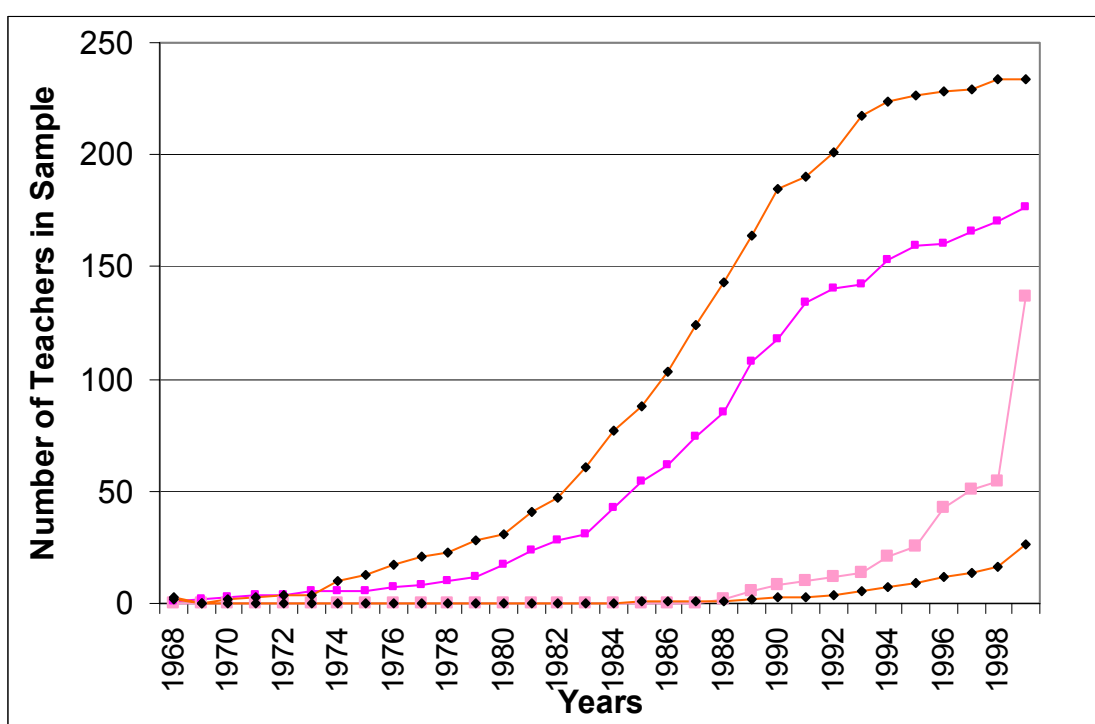
Source: ENAHO 1999

If we accept that the rate of unionization in the public educational system has been dropping in the last three decades, the data suggests that this phenomenon has been more dramatic in the 1990s, associated basically to the entry of non-tenured teachers who are less likely to be unionized.

It should be mentioned that the ENAHO sample is not necessarily representative of teachers, although given the importance of teachers in the total number of households (about 12% of households have a teacher within), it may be a good approximation.

Graph 2 shows the total number of teachers in the ENAHO sample by four categories in terms of unionization and labor contract. The horizontal axis displays the year in which teachers in the sample started teaching.

Graph 2



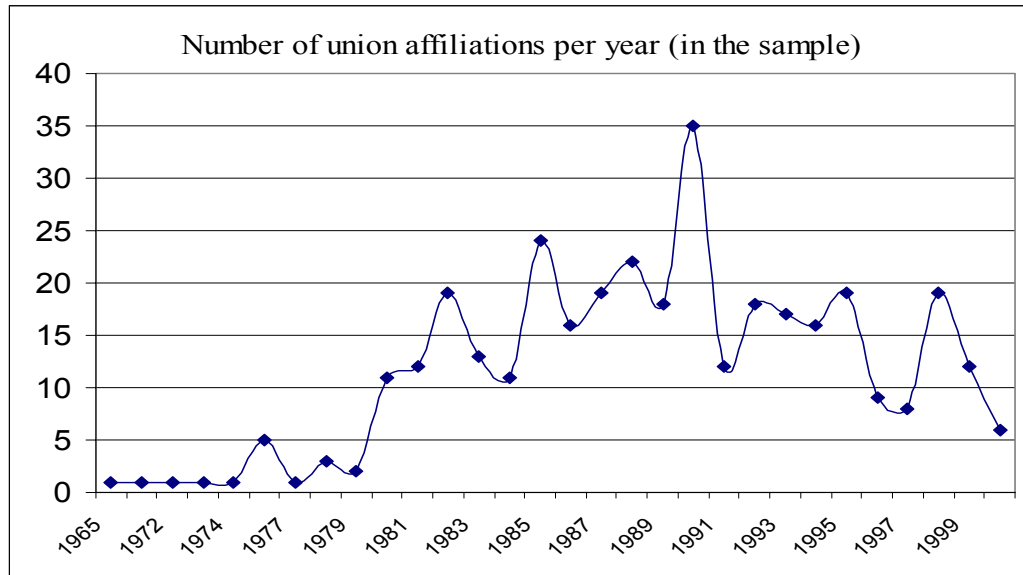
Source: ENAHO 1999

The graph gives support to the idea that lower unionization in the 1990s could be associated to the increasing importance of non-tenured teachers in that decade, especially after 1995. If we exclude hired teachers from the sample, the proportion of unionization is 57% instead of 45%. Thus, the average rate of affiliation to SUTEP may be about 60% among tenured teachers.

As displayed in Graph 2 below, the sample of teachers from the MECEP evaluation shows the same pattern seen in Table 1. Affiliation to the union has been much more

common in teachers with more than 10 years of experience compared to teachers who have entered the career recently. The presence of hired teachers in the last years is clearly one of reasons behind this as well.

Graph 3



Source: MECEP evaluation survey, MOE and Instituto APOYO

2.2. Teacher profile and union status

In **Table 2** we present the distribution of teachers taken from the ENAHO sample of teachers at the national level by type of location.

Table 2: Unionization of Teachers and location

	Non Unionized	Unionized	Rate of Union
Capital cities	81	52	39%
Big cities	58	68	54%
With more than 2,000 inh.	88	57	39%
Total urban	227	177	44%
500-2000 inhabitants	35	43	55%
Disperse	52	40	43%
Total rural	87	83	49%
Total	314	260	45%

Source: ENAHO 1999

As can be seen, unionization is larger in rural areas (49%) than in urban areas (44%) a difference that is statistically significant at the 95% confidence level. This result is consistent with interviews with SUTEP members who assure that the union presence in rural areas is strong.

Table 3 displays a similar breakdown for teachers' tenure status.

Table 3: Tenure Status of Teachers and location

	Non Tenured	Tenured	Rate of Tenure
Capital cities	26	107	80%
Big cities	36	90	71%
With more than 2,000 inh.	46	99	68%
Total urban	108	296	73%
500-2000 inhabitants	22	56	72%
Disperse	33	59	64%
Total rural	55	115	68%
Total	163	411	72%

Source: ENAHO 1999

As can be seen, non-tenured teachers are more likely be assigned to rural areas than tenured teacher, which reflects the increasing presence of temporary teachers in rural areas. This factor may affect negatively the rate of unionization in rural areas (temporary are less likely to enroll), although it was still not strong enough to make unionization less strong in rural areas than in urban ones. In general, as mentioned before, temporary teachers are currently being allocated to the poorest schools, which are generally located in rural areas without major incentives.

In Table 4 we present the proportion of teachers who have a secondary activity besides teaching, ordered by location. It can be seen that unionized teachers are more likely to have a secondary activity but this is mostly explained by hired teachers who are unionized (it may be claimed that these teachers affiliate to the union in order to have some extra protection from being fired). Unionized and tenured teachers have a slightly higher presence of secondary activities than non-unionized, but the difference is not significant in statistical terms.

Table 4: Secondary activity by teachers

	Non-Unionized			Unionized		
	Non-Tenure	Tenure	Total	Non-Tenure	Tenure	Total
<i>Have secondary activity(%)</i>						
Capital cities	38%	40%	40%	80%	40%	44%
Big cities	35%	52%	43%	80%	33%	37%
With more than 2,000 inh.	41%	39%	40%	57%	58%	58%
Rural 500-2000 inhabitants	53%	39%	46%	60%	55%	56%
Rural disperse	52%	65%	58%	25%	61%	57%
Total	43%	45%	44%	62%	48%	49%

Source: ENAHO 1999

Looking at other characteristics of teachers and their union status in the ENAHO sample of teachers, we ran a probit estimation of the probability of being unionized on some other features. The results are presented in Table 5:

Table 5: Factors affecting unionization rates

Probit estimates for Unionization of Teachers							
Number of obs	574						
LR chi2(6)	111						
Pseudo R2	0.141						
Log likelihood =	-339.7						
	dF/dx	Std. Err.	z	P>z	x-bar	[95%	C.I.]
Rural	0.079	0.049	1.62	0.10	0.30	-0.02	0.18
Tenure	0.323	0.054	5.21	0.00	0.72	0.22	0.43
Single	-0.086	0.056	-1.52	0.13	0.24	-0.19	0.02
Male	0.125	0.044	2.81	0.01	0.48	0.04	0.21
Age	-0.005	0.004	-1.06	0.29	34.93	-0.01	0.00
Experience (years)	0.015	0.006	2.73	0.01	9.05	0.00	0.03
obs. P	.4529617						
pred. P	.4356322 (at x-bar)						

Both rural location (although at 10% level of significance) and tenure status (a tenured teacher is 32% more likely to be unionized than a non-tenured) are clearly related to union status, confirming the statistical validity of the previous analysis of differences. In terms of the other features in the regression, we see that years as a teacher (experience) is an important variable associated with unionization. Even when we control by tenured status and location, the experience variable appears significant implying that unionization is more likely among teachers with more experience. Another important result is that male teachers are much more likely (13%) to be unionized than female teachers. Marital status and age appear as non-significant at the 10% level of significance.

Using the data from the MECEP evaluation survey we have similar results in terms of the variables analyzed with the ENAHO survey. However, the MECEP data gives us a little bit more information about teachers. For instance, in Table 6 we present the level of education and the institution from which teachers graduated. It can be seen that hired (i.e. non-tenured) teachers are more likely to come from an institute than from a

university. They are also more likely to come from a private institute in comparison with tenured teachers.

Table 6: Levels of Education of Teachers

	No Sutep			Sutep			TOTAL
	Hired	Tenure	Total	Hired	Tenure	Total	
Level of Education							
Only secondary	0	0	0	0	1	1	1
Institute	88	291	379	12	238	250	629
University	18	93	111	3	80	83	194
Other	2	35	37	1	18	19	56
Institution							
Public Institute	71	301	372	11	237	248	620
Private Institute	15	15	30	1	10	11	41
Public University	16	78	94	1	72	73	167
Private University	2	12	14	1	11	12	26
Other	4	13	17	2	5	7	24
Total	108	419	527	16	335	351	878

	Percentages by column						
	Hired	No Sutep Tenure	Total	Hired	Sutep Tenure	Total	TOTAL
Level of Education							
Only secondary	0.0%	0.0%	0.0%	0.0%	0.3%	0.3%	0.1%
Institute	81.5%	69.5%	71.9%	75.0%	71.0%	71.2%	71.6%
University	16.7%	22.2%	21.1%	18.8%	23.9%	23.6%	22.1%
Other	1.9%	8.4%	7.0%	6.3%	5.4%	5.4%	6.4%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Institution							
Public Institute	65.7%	71.8%	70.6%	68.8%	70.7%	70.7%	70.6%
Private Institute	13.9%	3.6%	5.7%	6.3%	3.0%	3.1%	4.7%
Public University	14.8%	18.6%	17.8%	6.3%	21.5%	20.8%	19.0%
Private University	1.9%	2.9%	2.7%	6.3%	3.3%	3.4%	3.0%
Other	3.7%	3.1%	3.2%	12.5%	1.5%	2.0%	2.7%

Source: MECEP Evaluation Survey, MOE, Instituto APOYO

In this sample we have that 9% of teachers who are not titled, proportion which is bigger for unionized teachers (10% versus 6% in the non-unionized). In the non-unionized group, non-titled teachers come exclusively from hired teachers, whereas in the unionized group lack of title is the same for hired and tenured teachers.

2.3. Access to educational resources

Teachers may have differentiated access to educational resources according to different characteristics and the decisions made by the MOE. In this sub-section we analyze the access of teachers to some educational resources using data from the MECEP evaluation study.

In Table 7 we present some data related to educational infrastructure by teachers according to their tenure and unionization status. As can be seen, tenured teachers are more likely to be located at bigger and better schools (*polidocentes*) than non-tenured teachers. In other words, non-tenured teachers are more likely to be present in *unidocente* schools, i.e., rural schools.

Table 7: Infrastructure and teachers' union and tenure status

	Non-Union		Union		Total
	Non-Tenure	Tenure	Non-Tenure	Tenure	
Teachers	188	419	46	454	1107
<i>School features</i>					
Polidocente	22%	57%	17%	62%	52%
Multigrado	37%	43%	20%	36%	38%
Unidocente	42%	0%	63%	2%	11%
Drinkable water	52%	73%	50%	78%	71%
Electricity	23%	54%	22%	61%	50%
Sewarage	17%	44%	11%	53%	42%
Director in Sutep	20%	28%	93%	43%	36%
<i>Local features</i>					
Drinkable water	58%	73%	59%	81%	73%
Electricity	28%	56%	26%	64%	54%
Sewarage	16%	42%	9%	52%	40%
Health center	33%	66%	33%	69%	60%
Hospital	4%	18%	2%	20%	16%
Telephone	18%	45%	11%	54%	42%
Paved road	29%	48%	20%	64%	50%
Bank	3%	17%	2%	25%	17%
Police station	10%	29%	11%	38%	29%
Secondary school	18%	49%	17%	60%	47%
Spanish	61%	79%	76%	84%	78%

Source: MECEP Evaluation, MOE, Instituto APOYO

This pattern clearly affects access to educational infrastructure and local features. *Polidocente* schools are more likely to have electricity and drinkable water. Also, in terms of the context in which the school is located, it is also apparent that *polidocente* schools are more likely in urban areas and so, have better local services. This analysis suggests that in comparing access to educational resources by unionized or non-unionized teachers we need to control for type of school

The Table shows that when the surveyed teacher is affiliated to SUTEP it is more likely that the director of the school is also a member of the union. This seems to be related to the fact that in *multigrado* and *unidocente* schools the interviewed teacher is generally the director of the school as well.

In order to make the analysis easier and to incorporate other variables associated to the teachers, we built an index of access to educational infrastructure in which school features have a weight of 75% and local services 25%². This index gives a good idea of differences in school quality, i.e., in access to educational infrastructure by teachers.

We ran two regressions, one for *polidocente* schools and the other for *multigrado* schools in order to see whether there are some differences in teachers' access to educational resources controlling by type of school (we had some problems with the teacher's data for *unidocente* schools). The results are presented in Table 8.

² The index was built as follows: there were 17 items of access to infrastructure, 11 for local services and 6 for school services, so we have two vectors with 11 and 6 components. We took the ratio of existent services in each vector (a value between 0 and 1) and weighted by 0.25 the local services and by 0.75 the school services, getting the total index for infrastructure.

Table 8: Effects of unionization on access to infrastructure

Regression of Infrastructure index on teacher features

Polidocente schools

Number of obs	482.0
F(5, 476)	53.2
Prob > F	0.00
R-squared	0.36
Adj R-squared	0.35
Root MSE	0.19

	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
Union	0.011	0.018	0.603	0.547	-0.025 0.046
Tenured	0.049	0.031	1.583	0.114	-0.012 0.109
Number classrooms	0.022	0.001	15.289	0.000	0.019 0.024
Male	-0.038	0.018	-2.043	0.042	-0.074 -0.001
Age (years)	0.022	0.012	1.734	0.084	-0.003 0.046
Constant	0.200	0.039	5.182	0.000	0.124 0.276

Regression of Infrastructure index on teacher features

Multigrado schools

Number of obs	382
F(5, 376)	8.28
Prob > F	0.00
R-squared	0.10
Adj R-squared	0.09
Root MSE	0.21

	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
Union	0.049	0.023	2.135	0.033	0.004 0.094
Tenured	0.001	0.028	0.052	0.959	-0.053 0.056
Number classrooms	0.043	0.007	5.913	0.000	0.029 0.058
Male	-0.001	0.001	-0.537	0.592	-0.004 0.002
Age (years)	-0.001	0.001	-1.001	0.317	-0.003 0.001
Constant	0.084	0.035	2.377	0.018	0.015 0.154

As can be seen, in the case of *polidocente* schools the union and tenure status do not seem to play a role in the differential access. However, all other variables are significant at 10%, implying that female and older teachers have better access. Also, the number of classrooms (school size) is clearly associated to the quality of infrastructure as expected.

In the case of *multigrado* schools, which are smaller than *polidocentes* and much more likely to be in rural areas (in the MECEP evaluation we did not have defined rural-urban location), the union status seems to play a role in improving access to infrastructure. This is so too for the number of classrooms or school size (in this case the variation is only within the *multigrado* schools). Tenure, age and gender do not have statistically significant coefficients in the regression.

In these regressions we are assuming a causality from unionization to access, an assumption which can be challenged as teachers with better access may have more incentives to become unionized. The use of panel data (with teachers changing union status through time) or finding a good instrumental variable linked to unionization but not to access may help to solve this problem, but were not able to have either of them. In this case the only conclusion that can be derived is that there is a positive correlation between unionization and access to infrastructure but only for *multigrado* schools, (which are smaller and more rural) relation which requires further investigation using more appropriate data.

In this section we have found empirical evidence about potential factors affecting unionization of teachers and correlations between union status and access to educational infrastructure. We did not talk about how unionization may affect the quality of the education service provided by the State. In the next section we develop a model to

assess this issue. We use this model to test hypothesis regarding the impact of unionization on educational services.

Section 3: A Production Function model for assessing the impact of Unionization on the provision of education

In order to consider the potential impact of unionization on the quality of educational services we will use a production function approach such as Hoxby's (1996) to analyze the impact of teacher unionization on educational services in the United States. We will use the "classroom" as the unit of analysis for the specification. Furthermore, each classroom is associated with one teacher mainly, as we are focusing on primary education.

We define a generic production function for educational services in a given classroom as:

$$y = f(\underline{e}, r; h) \quad (1)$$

where $f(\cdot)$ is a well defined function; "y" is a measure of student achievement; " \underline{e} " represents the effort level supplied by the classroom's teacher in educational processes; "r" are physical inputs used by the teacher and students (books, pedagogical materials, etc.) "h" is a vector representing other geographic, school, teacher, and student characteristics. As usual, it is assumed that $f'_e > 0$; $f''_e < 0$; $f'_r > 0$; $f''_r < 0$; $f'_{er} > 0$; so "e" and "r" are inputs with decreasing returns given any fixed input and are complementary in the production of educational services.

Departing from Hoxby's model for the U.S. (where teachers have influence on budget decisions and input allocation), we will specify a model in which the only variable that teachers control is effort level:

$$e = g(w; u, t, v) \quad (2)$$

where w is the implicit cost or disutility of effort for the teacher, u is union status, t is tenure status, and v are specific teacher characteristics.

Equations (1) and (2) have the form of a production function in which effort enters as an input in the production equation, and it depends on prices and institutional variables. As generally effort cannot be directly measured, most studies estimate a reduced form plugging (2) into (1).

In our case, however, we have alternative direct measures of effort which we will use in the estimation of equation (1). The output measure is taken from math and language tests applied to a sample of students in the MECEP evaluation.

Looking for a direct measure of effort

In the MECEP evaluation³, there is in-class observation data from which we have taken three variables which can be used to approximate teachers' effort: (i) use of time in class; (ii) good control of the classroom and (iii) students opinions about the teacher. From the students' survey we have taken their opinion about their teachers ability and behavior. The mean of these variables for unionized and non-unionized teachers are shown in Table 9⁴.

³ Look at Annex 1 for a brief description of the MECEP evaluation dataset.

⁴ In the case of the sub-sample of 90 classes used for in-class observation we did not have non-tenured teachers so the tenure variable cannot be used in the analysis.

Table 9: Teacher Behavior in Class

	Non-Union	Union	Total
<i>Use of time in class (minutes)</i>			
Time required	261	266	263**
Time observed	213	203	208**
Lecturing	38	29	33**
Dialog	27	34	31**
Students reading	16	25	21**
Students writing	66	69	68*
Individual work	52	50	51
Group work	47	54	51**
No attention	23	21	22**
<i>Good control of class</i>			
Good Knowledge (1 to 4)	3.12	3.20	3.16**
Clarity (1 to 4)	3.06	3.18	3.12**
Conduct control (1 to 4)	2.80	3.11	2.96**
<i>Students opinion about the teacher</i>			
Answers my questions	90%	90%	90%
Is concerned about my learning	91%	87%	89%**
He/she hits me when I misbehave	51%	40%	45%**
Does not show up to class often	15%	15%	15%
Is late often	21%	18%	19%*
Is good explaining	91%	93%	92%*
Asks for questions in class	86%	85%	86%
Asks us to use books from library	77%	76%	76%

*Source: In-class observation and student survey, MECEP Evaluation, sample size: 90 classrooms. ** Means are different at 95%; * Means are different at 90%.*

The means among the two groups (unionized and non-unionized) are statistically different for most variables. However, there are some variables in which differences are not significant, mostly in students' opinions about their teachers.

In terms of the use of time, the duration of daily sessions seems to be smaller for unionized teachers, who have a total of 203 minutes per day versus 213 minutes per day of non-unionized ones. In average, the sessions reach a 79% of the total required time,

but unionized teachers accomplish only 77% of the required time versus 82% for non-unionized. This may imply that unionized teachers tend to devote less time to teaching.

Despite the absolute time devoted to daily sessions, it is important to see for the use of that time. According to what trained observers report, teachers use about one hour daily for proper teacher activity (lecturing and talking with students). The use of that time is different by unionization status: unionized teachers have less time lecturing and more time dialoguing with students than non-unionized ones. It is not clear whether these differences may be important in terms of the quality of teaching, although it seems that unionized teachers seem to involve students more in class activity.

In terms of the second variable, good class control, the observers qualified teachers behavior with a scale from 1 to 4 in terms of knowledge of the matter taught; clarity of explanations and conduct control in class. In all these items unionized teachers did better, showing a better class management.

Students' opinions about their teachers do not show major differences among unionized and non-unionized except for the question about hitting in class. A 45% of children declared that teachers hit them in class sometimes, percentage which is bigger for non-unionized teachers (51% versus 40%). This is consistent with observers reporting a better class control by unionized teachers. In all other issues consulted to students there seems not to be significant differences

Looking at this information, we think that the variables associated with class management are a possible measure of **teacher effort** in class. The use of this variable as a proxy for effort has two limitations: (i) it is possible that some specific factors related to the children in the classrooms, i.e., a small number of disruptive children, may affect and distort the measure as in this case a lower control may in fact reflect a higher effort by the teacher; (ii) the observation of how teachers work in class by informed

observers can in some way alter teacher behavior. Even considering these two limitations, we think that this variable is the best we can get from the MECEP evaluation. The observation distortion, also, should not affect the variation between unionized and non-unionized teachers which is the variation we need for our estimation. In the empirical analysis that follows we will use the sum of the three class control variables as a proxy for teacher effort in class.

Section 4: Production function analysis

The dataset we use for the estimation is that of 90 classrooms in which math and language test scores were applied to students and in which teacher practices and their use of inputs were observed during three days by specialized observers. This dataset has most of the variables used in equation (1) from our model.

This dataset, however, has some limitations given its relatively small size. After the evaluation, we found that in only 65 classrooms the evaluators asked the question about unionization. Within this sample, 15 teachers did not respond to this question, which leaves a total of only 50 classrooms for analysis with the union variable.

An additional feature of the data was that all the teachers in the 90 classrooms sampled were tenured. This is not a bad thing for our estimation, as we want to avoid mixing up union and tenure status effects. Using a dataset in which all teachers are tenured allow us to check for pure union impacts. Another important feature of this dataset is that there were not *unidocente* (mostly rural) schools in it, so that dimension is excluded from the analysis.

Still, as we have complete information about the 90 classrooms and teachers when we do not consider the union variable, we will start our estimation process abstracting for a

moment from the union variable. We will introduce the union question after estimating the production function for the whole 90 classroom dataset.

5.1. The production function without union status

Based on equation (1) of the model we will estimate the following equation:

$$Y = \alpha + \beta_1 N + \beta_2 C + \beta_3 T + \beta_4 r + \beta_5 e + u \quad (3)$$

where Y is the log of average student achievement or result (standardized test scores) for the classroom, N and C are vectors of student and community characteristics, T are teacher characteristics (gender, experience) r is input use by teacher (textbook), and e is effort in teaching measured as the sum of the three variables of class control described in section 4.

Because the sampling scheme used for the MECEP evaluation implies that what are selected are classrooms, we corrected the standard errors of the estimation using the Software ©*Stata* Version 5.0 with an option for sample design in running regressions (the routine is called *svyreg*). This gives estimations with standard errors which consider the fact that students are clustered in the 90 classrooms. The regression results are presented in Table 10.

Table 10**Production Function Regression**

<i>Math test</i>	
Number of obs	2270
Number of strata	1
Number of PSUs	88
Population size	2270
F(8, 80)	10.58
Prob > F	0
R-squared	0.1636

	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
Effort	0.0772	0.0439	1.7590	0.0820	-0.0100	0.1644
Use of text	0.0344	0.0190	1.8080	0.0740	-0.0034	0.0722
Urban area	0.0394	0.0296	1.3320	0.1860	-0.0194	0.0981
Student works	-0.0522	0.0118	-4.4250	0.0000	-0.0757	-0.0288
School index	0.1967	0.0621	3.1690	0.0020	0.0733	0.3200
Sixth grade	0.0022	0.0201	0.1070	0.9150	-0.0378	0.0422
Experience	-0.0096	0.0103	-0.9340	0.3530	-0.0300	0.0108
Teacher male	-0.0517	0.0256	-2.0200	0.0460	-0.1026	-0.0008
Constant	5.4073	0.1007	53.6820	0.0000	5.2071	5.6075

<i>Language Test</i>	
Number of obs	2309
Number of strata	1
Number of PSUs	88
Population size	2309
F(8, 80)	17.09
Prob > F	0
R-squared	0.186

	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
Effort	0.0901	0.0391	2.3020	0.0240	0.0123	0.1678
Use of text	-0.0653	0.0303	-2.1540	0.0340	-0.1256	-0.0050
Urban	0.0973	0.0291	3.3400	0.0010	0.0394	0.1552
Student works	-0.0456	0.0165	-2.7550	0.0070	-0.0785	-0.0127
School index	0.1360	0.0484	2.8100	0.0060	0.0398	0.2323
Sixth grade	0.0117	0.0197	0.5940	0.5540	-0.0275	0.0509
Experience	0.0000	0.0111	-0.0020	0.9980	-0.0220	0.0220
Teacher male	-0.0488	0.0225	-2.1650	0.0330	-0.0936	-0.0040
Constant	5.3629	0.0874	61.353	0.0000	5.1892	5.5366

As can be seen, most variables are statistically significant and have the expected sign. In particular, teachers' effort, measured as the sum of the three class control variables, has a positive coefficient at 8.2% significance level for math test, and at the 2.4% for language test, implying that what teachers do in class have a clear impact on student achievement. The use of the textbook appears to be positive for student achievement in math, but negative in the language test. It seems that the math textbook is having a better impact on students than language textbooks according to these estimations.

The fact that a student works have a negative impact on student achievement, both in math and language, whereas the index of school quality favors student achievement in both cases. Teacher experience appears with a coefficient no significantly different from zero, whereas male teachers tend to have a lower performance in terms of math and language tests.

5.2. Production function with union analysis

We first estimate a regression of effort on union status and other teacher and school characteristics and correcting by clustering. Table 11 presents the results, indicating that union status does not play a role in effort supply by teachers. School quality and experience appear as variables with a positive impact on effort.

Table 11
Regression of Unionization on Effort

Number of obs	1329
Number of strata	1
Number of PSUs	50
Population size	1329
F(5, 45)	2.18
Prob > F	0.0734
R-squared	0.1697

	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
Union	0.0428	0.0461	0.9280	0.3580	-0.0499 0.1354
Urban	-0.0389	0.0596	-0.6530	0.5170	-0.1587 0.0809
School index	0.2661	0.1394	1.9090	0.0620	-0.0141 0.5462
Experience	0.0725	0.0352	2.0630	0.0440	0.0019 0.1432
Male	0.0272	0.0470	0.5780	0.5660	-0.0673 0.1216
Constant	1.8673	0.1124	16.6170	0.0000	1.6414 2.0931

For testing the direct role of unionization on student achievement, we ran a regression on test score including union as an independent variable but excluding effort. As can be seen in Table 12. for both math and language, the unionization coefficient does not appear statistically different from zero at 10% of significance. In the case of math scores, the coefficient is positive and significant at the 13.2%, whereas for language score, the coefficient is negative. The other coefficients have similar behavior than in the larger dataset of 90 classrooms, suggesting that the production function specification was not altered by the smaller sample taken (of 50 classrooms).

Table 12

Production Function Regression with Union Variable

Math test

Number of obs	1283
Number of strata	1
Number of PSUs	50
Population size	1283
F(8, 42)	5.53
Prob > F	0.0001
R-squared	0.1487

	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
Union	0.0352	0.0230	1.5330	0.1320	-0.0109 0.0814
Use of text	0.0488	0.0240	2.0340	0.0470	0.0006 0.0970
Urban	0.0266	0.0485	0.5480	0.5860	-0.0709 0.1241
Student works	-0.0458	0.0169	-2.7130	0.0090	-0.0798 -0.0119
School index	0.1778	0.0907	1.9600	0.0560	-0.0045 0.3601
Sixth grade	0.0188	0.0298	0.6310	0.5310	-0.0411 0.0787
Experience	0.0024	0.0141	0.1700	0.8660	-0.0259 0.0307
Teacher male	-0.0728	0.0338	-2.1530	0.0360	-0.1407 -0.0049
Constant	5.5539	0.0588	94.4060	0.0000	5.4356 5.6721

Language Test

Number of obs	1292
Number of strata	1
Number of PSUs	50
Population size	1292
F(8, 42)	6.6
Prob > F	0
R-squared	0.1714

	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
Union	-0.0026	0.0306	-0.0860	0.9320	-0.0641 0.0589
Use of text	-0.0959	0.0418	-2.2930	0.0260	-0.1799 -0.0118
Urban	0.0819	0.0521	1.5710	0.1230	-0.0229 0.1867
Student works	-0.0305	0.0236	-1.2890	0.2030	-0.0780 0.0170
School index	0.2167	0.0750	2.8880	0.0060	0.0659 0.3674
Sixth grade	0.0306	0.0312	0.9820	0.3310	-0.0321 0.0934
Experience	0.0176	0.0165	1.0610	0.2940	-0.0157 0.0508
Teacher male	-0.0724	0.0315	-2.3000	0.0260	-0.1356 -0.0091
Constant	5.4752	0.0717	76.3560	0.0000	5.3311 5.6193

Section 5. Conclusions

In this research we have put together two sources of quantitative information for answering questions regarding the extent, profile and role of teachers' unionization on the quality of public education in Peru.

Analyzing the cross-section data taken from ENAHO 1999 and the MECEP evaluation study, we find evidence compatible with the hypothesis that unionization has been declining in the last three decades, especially during the 1990s due to the hiring of temporary teachers. From rates of 70 to 80% for teachers who started working in the 1970s, the rate of unionization currently is less than half the teacher population. It is not clear if this trend will continue in the near future as the current government started a process of eliminating the figure of temporary teachers in public education.

Unionized teachers tend to be older and more experienced, and are more likely to be male. Most of unionized teachers are tenured, although there is a small set of non-tenured teachers who are members of the union. The presence of the union in rural areas is still important, and is related to the electoral mechanisms for union representation.

In terms of access to educational infrastructure, the MECEP evaluation data indicates that unionized teachers do not enjoy access to better infrastructure at the *polidocente* schools, but that they have better access at the *multigrado* schools (which are an intermediate between *polidocente* and *unidocente* or rural schools). This may imply that unionized teachers are more successful in improving their position at this intermediate level, but with no ability to do so for larger schools.

In this research we were able to identify variables directly linked to teacher effort, facilitating the estimation of a reduced form of the traditional production function like Hoxby's. The estimation of the production function for a sample of 90 classrooms

without union analyzes indicates that the effort variable work well and that despite the smallness of the dataset, we can have the expected signs for most of the independent variables. Using the smaller dataset with the union variable, we find that unionization does not play a role either in the supply of effort by teachers or in the test scores in math and language. Thus, in the Peruvian case, this preliminary evidence suggest that unionization may not affect the provision of public education in a definite way.

Annex 1. Description of the MECEP evaluation database

At the end of 1995 the Ministry of Education (MOE), Inter-American Development Bank (IADB) and World Bank (IBRD) jointly designed and created a nationwide program to improve the quality of primary education –MECEP-. The program was designed to achieve improvements in the quality of education through the introduction of new teaching practices, modernization of the administrative process, and through the rehabilitation of existing infrastructure.

A team at Instituto Apoyo made a comprehensive evaluation (Instituto Apoyo c) of the effects and impacts of plan MECEP throughout Peru. A by-product of the evaluation is a large database, described below, which will allow an exploration of the determinants of the quality of education at the primary level and how these relationships are affected by the union status of the teachers.

The first part of Instituto Apoyo's MECEP database is comprised of teacher and school director answers to detailed questionnaires. Of a total of 26,606 education centers throughout Peru, a random sample of 700 was chosen using stratification methodologies that ensure representative samples with respect to geography, size, and involvement of MECEP. Furthermore, within the 700 schools, three classrooms (one of each of second, fourth, and sixth grades) were randomly chosen⁵. The result is a dataset of approximately 2,200 teachers and 700 school directors throughout Peru. A summary of the main variables of interest follows.

- I Geographic Location
 - a. Department
 - b. Province
 - c. District
 - d. Locality
- II School ID
 - a. Nationwide MOE school ID
- III School Characteristics
 - a. Access to basic services (light, water, sewage)
 - b. Government intervention through some social program
 - c. Type of social assistance
 - d. Other groups that provide social assistance
- IV Teacher Profile
 - a. Sex
 - b. Age
 - c. Educational Level
 - d. Years of study
 - e. Place of study
 - f. Specialty of study
 - g. Licensed/not licensed as a teacher
 - h. Tenured / contracted teacher
 - i. Member / non-member of teacher's union (SUTEP)
 - j. Number of years as a teacher
 - k. Training under MECEP program

⁵ With the exception of single-classroom/single-teacher (unidocente) schools, from which only one sample was extracted

- l. Number of years trained
- m. Place of geographic origin
- V Characteristics of teacher's job
 - a. Number of grades taught
 - b. Number of primary grades taught
 - c. Years dedicated to teaching
 - d. Years teaching at current school
 - e. Attendance of teacher
- VI Materials & Curricula
 - a. Availability of educational materials
 - b. Use of educational materials
 - c. Use of consolidated curriculum
- VII Teacher Training
 - a. Use of methods learned during teacher training
 - b. Perception regarding the new methods learned

Furthermore, a subset of 90 classrooms (randomly chosen from 45 of the 700 schools) were selected for a second phase of the evaluation. Standardized tests that will gauge student aptitude in basic language and mathematics skills will be administered to 30 students in each of the 90 classrooms and the corresponding teachers were evaluated as to the use of new pedagogical techniques and practices. A small survey to all the 2700 students got information about their socio-economic background and their opinions about their teacher.

The evaluators conducted 3-day *in situ* evaluations of the teachers' techniques, practices and use of educational materials. A detailed analysis of the resources available to the class (blackboards, desks, books, computers, etc) as well as an assessment of the effort and/or dedication of the teachers was also part of the three-day evaluations. The information from these evaluations is of critical importance for this research. Evaluators were really trying to gather information not only about input availability and practices as declared by teachers but also about input use and practice adoption from a more objective point of view. Also, they were able to give an opinion about the teacher's ability in class, something which is rarely available for empirical research. It is clear that the information has also limitations, as the presence of the evaluator may have changed teacher behavior.

The variables of interest from the second phase of the evaluation are presented below:

- I. Classroom Environment & Materials
 - a. Classroom layout
 - b. Availability and condition of blackboards
 - c. Usage of wall space
 - d. Availability and condition of desks and chairs
 - e. Condition of teacher desk
- II. Educational Materials
 - a. Availability and usage of books
 - b. Various observations regarding the use of books in teaching
 - c. Existence and usage of library
 - d. Additional materials (Geometric figures, balances, lab equipment, etc)
- III. Duration of Class

- a. Total duration
- b. Duration of lecture
- c. Duration of dialog and student interaction
- IV. Pedagogical Activities
 - a. Group work
 - b. Form of supervision
- V. Teacher Aptitude
 - a. Logic/Mathematics
 - b. Communication
 - c. Language
- VI. Teacher disposition (aggression, indifference, authoritarianism, etc)

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