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Skills and Selection into Teaching: Evidence from Latin America

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ABSTRACT

This paper documents a novel stylized fact: many teachers in Latin America have low levels of cognitive skills. This fact is the result of both low levels of skills among the population and—in the case of numeracy—a gap between the average skill level of teachers and the rest of the tertiary-educated population (i.e., a teacher skills gap). To characterize the selection patterns behind this gap, we show that individuals with a teaching degree have lower average skills than individuals with other tertiary degrees, and that this gap is larger than the teacher skills gap. This difference is mainly explained by the selection into teaching of graduates from non-teaching degrees. Finally, we show evidence on one important determinant of the teacher skills gap: teacher relative wages are decreasing in skills.

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1 INTRODUCTION

Teachers are a key determinant of student learning, and the impact of being assigned to a highly effective teacher persists into adult life (Rivkin et al. 2005; Chetty et al. 2014). It is therefore unsurprising that concerns about the low levels of student learning affecting many developing countries overlap with concerns about the capacity of those countries' education systems to attract, select, and retain high-quality teachers and to effectively train and motivate teachers.

Although the identification of high-quality teachers remains somewhat elusive, particularly at the moment of hiring, there is some agreement on the idea that individuals with higher cognitive and non-cognitive skills can be better teachers.[1] Several papers have shown that teacher skills are indeed connected to student learning (Rockoff et al. 2011; Gronqvist and Vlachos 2016; Hanushek et al. 2019).[2]

Motivated by such findings, a string of papers has documented a secular decline in the skills profile of the teaching force in developed countries (Nickell and Quintini 2002; Corcoran et al. 2004; Fredriksson and Öckert 2008). There is no comparable evidence for developing countries on the skills of teachers or their evolution, mainly because of the absence of representative data on both cognitive and non-cognitive skills, and occupational status for the adult population.[3]

In this paper, we use a recently released dataset from an international survey on adults' skills with information on four Latin American countries and ask ourselves: what levels of cognitive skills do teachers have in these countries and where do they lie in the skills distribution of tertiary-educated individuals? We then turn our attention to a set of selection patterns into the teaching profession (related to schooling and occupational choices) that shape the skills profile of current teachers. Finally, we examine one feature of the labor market that can influence the selection by skills into teaching: how wages vary with skills.

Latin America is a middle-income region formed by countries with low levels of student learning with respect to their national income and education expenditure as a share of GDP (Izquierdo et al. 2018). To say that the region performs below expectations is an understatement. In the words of Hanushek and Woessmann (2012): "The performance of Latin American countries on the worldwide student achievement tests has been truly dismal." Using an instrumental variables approach to deal with the endogeneity of educational achievement, these authors argue that the low levels of cognitive skills in the region can explain why economic growth in Latin America lagged behind the rest of the World during the second half of the twentieth century.

We focus our analysis on Chile, Ecuador, Mexico, and Peru, the four Latin American countries that participated in the Programme for the International Assessment of Adult Competencies (PIAAC) from the Organisation for Economic Co-operation and Development (OECD). These four countries account for approximately one third of the population in Latin America. They span most of the distribution of GDP per capita of the Spanish speaking countries in the region, with the exception of Bolivia, the low-income countries in Central America and (richer) Panama. The PIAAC survey assesses literacy, numeracy, and problem solving skills on nationally representative samples of the adult population, in addition to collecting detailed occupation and schooling information. Using this information, we identify and center our analysis on the numeracy and literacy skills of preschool and K–12 teachers. We compare the selection patterns of Latin American teachers with those of successful educational systems. In particular, we benchmark against 17 OECD countries with high performance in the Programme for International Student Assessment (PISA)—another

1 The variance of teacher effectiveness (i.e., value-added to student achievement) is large and weakly correlated to characteristics that are easy to observe, except for the first years of teaching experience (Hanushek and Rivkin 2006; Rockoff et al. 2011).

2 A related strand of papers uses data from developing countries to show that teacher subject knowledge shapes student learning. See Metzler and Woessmann (2012) on Peru, Bau and Das (2020) on Pakistan, and Bietenbeck et al. (2018) on 13 countries in sub-Saharan Africa—although Marcenaro-Gutierrez and Lopez-Agudo (2020) do not find an effect of teacher subject knowledge when they focus on a subsample of three sub-Saharan countries in which higher quality data is available.

3 This definition of developing countries is inclusive of upper middle-income countries—as defined by the World Bank—and countries, like Chile, which have recently surpassed the high-income threshold defined by the same institution.

OECD survey, which assesses the skills of 15-year-old students.[4] The selection of these countries is motivated by the findings in Hanushek et al. (2019), which documents a positive relationship between teachers' cognitive skills as measured by PIAAC and student test scores in PISA.

Our main findings show that many teachers in Latin America have low absolute levels of cognitive skills. About half of the teachers in these countries score at the lowest two proficiency levels (out of six) in the numeracy and literacy domains of the PIAAC survey. This implies, for example, that they have difficulty understanding basic statistics and comparing two pieces of information from a text. This low level of skills is the result of both low levels of skills among the population in these countries and—in the case of numeracy—a gap between the average skills of teachers and the rest of the tertiary-educated population (i.e., a teacher skills gap).[5] Teachers in the region have numeracy and literacy scores that are on average 0.15 and 0.08 standard deviation (SDs), respectively, lower than other employed individuals with a tertiary education; although only the difference in numeracy is statistically significant (at the 5 percent level). Furthermore, teachers are 8 and 4 percentage points more likely than non-teachers to have a numeracy and literacy score, respectively, in the two lowest proficiency levels (again, only the gap in numeracy is significant at conventional levels).[6] We do not find such low levels of skills among teachers in high-performing OECD countries.

As obtaining a teaching degree is the main path to a teaching career, it seems natural to ask how the teacher skills gap maps to the skills profile of education graduates vis-à-vis other tertiary graduates. As one could expect, we observe that teaching degree graduates tend to have lower levels of skills than other tertiary graduates. A less obvious finding is that this gap is larger than the teacher skills gap. In these countries, individuals with a teaching degree have numeracy and literacy scores that are on average 0.29 and 0.23 SDs, respectively, lower than individuals with other tertiary degrees. Furthermore, teaching-degree graduates are 11 and 8 percentage points, respectively, more likely than other tertiary graduates to have a numeracy and literacy score in the two lowest proficiency levels, and 2 percentage points, respectively, less likely to have a score in the top two proficiency levels in both domains. The first four of these results are statistically significant at the 1 percent level and the last two at the 10 percent level.

We show that most of the difference between the teacher skills gap and the education graduates skills gap is accounted for by the selection of non-education graduates into teaching. Teachers with non-teaching degrees have higher numeracy and literacy scores on average than teachers with a teaching degree, by 26 and 22 percent of a SD, respectively (although only the numeracy gap is statistically significant). This is not an obvious result even if non-education graduates have higher average skills than education graduates because it depends on how teachers are selected from the pool of individuals with non-education degrees. When we investigate this selection process, we find that non-education graduates who work as teachers have the same skills, on average, than those who work in other professions. We also find suggestive evidence of another selection pattern: teaching-degree graduates who become and remain teachers seem to have higher levels of skills than those who are not teachers. The first group has average numeracy and literacy scores that are 0.08 percent of a SD higher. However, these differences are not statistically significant.

Several studies have documented that Latin American teachers tend to have lower monthly wages than tertiary-educated individuals working in other occupations, though their hourly wages tend to be higher (Bruns and Luque 2014; Mizala and Ñopo 2016; Elacqua et al. 2018; Estrada 2019). As such gaps are generally estimated using ordinary least squares regressions in which researchers control for the observable characteristics available in labor force surveys (typically gender, age, and schooling), it is not clear whether these differences still hold after taking into account the teacher skills gap. We take advantage of the availability of data on wages and cognitive skills in PIAAC and show that even when controlling for skills, teachers tend to have lower (higher) monthly (hourly) wages than other tertiary graduates. Furthermore, we find a weaker relationship between wages

4 Indonesia, Kazakhstan, Turkey, and seven Eastern European countries also took part in the PIAAC survey.

5 Eighty-eight percent of teachers in the four Latin American countries in our sample have a tertiary degree and hence we restrict our analysis to tertiary-educated individuals.

6 Because of sample size restrictions, our main results are estimated at the aggregated level. Estimates at the country level are available in the Appendix and are qualitatively consistent with the results discussed here. Note, though, that due to lack of precision the country-level results should be taken with caution.

and skills in the teacher labor market than in the market for other tertiary graduates. In other words, teachers' relative wages decrease with skills, both for monthly and hourly wages.

Because of data limitations, there is little direct evidence from developing countries on the cognitive skills that teachers have and their position in the skills distribution. To circumvent this obstacle, a few studies have documented the skills gap between students enrolled in education programs and those enrolled in other tertiary degrees in Latin America (see Neilson et al. (2019) on Chile; Elacqua et al. (2018) on Colombia and Chile; de Hoyos, Estrada and Vargas (2018) on Mexico; and Ortega (2010) on Venezuela).[7] However, as we show in this paper, the skills distribution of education students does not necessarily mirror the skills distribution of teachers. Our first contribution is, hence, to provide novel evidence on an understudied topic of high policy relevance: the skills profile of teachers in Latin America.[8] Furthermore, to better understand the determinants of the teacher skills gap, we characterize different selection processes that define the stock of teachers. Finally, we provide novel evidence on the relationship between the teacher wage gap and cognitive skills. Our findings back up a long-held belief in developing countries: teachers' relative wages are decreasing in skills.

The findings presented here are relevant for education policy. Although Latin American teachers frequently perform tasks that require reading, writing, and numeracy skills (Figure 1), many of them have very low levels of cognitive skills, which could compromise their capacity to adequately perform their job.[9] Cognitive skills are only one dimension of teacher quality, but it seems hard to imagine that an education system can steadily improve student learning if many teachers lack basic competencies and, for example, have difficulty understanding basic statistics and comparing two pieces of information from a text. As the low level of skills is more prevalent among graduates from education degrees, the screening mechanisms that determine the access to teacher colleges (Neilson et al. 2019) and teaching jobs (Estrada 2019) deserve a high level of attention. Recruiting individuals with non-teaching degrees is useful to improve the pool of teachers in terms of cognitive skills, although they might need to acquire specific teaching skills to be effective teachers. Finally, given the documented weak relationship between wages and skills in the teacher labor market, policies directed at making teacher wages—and more generally progress in the teaching career—less dependent on seniority and more dependent on performance and skills are worth exploring.

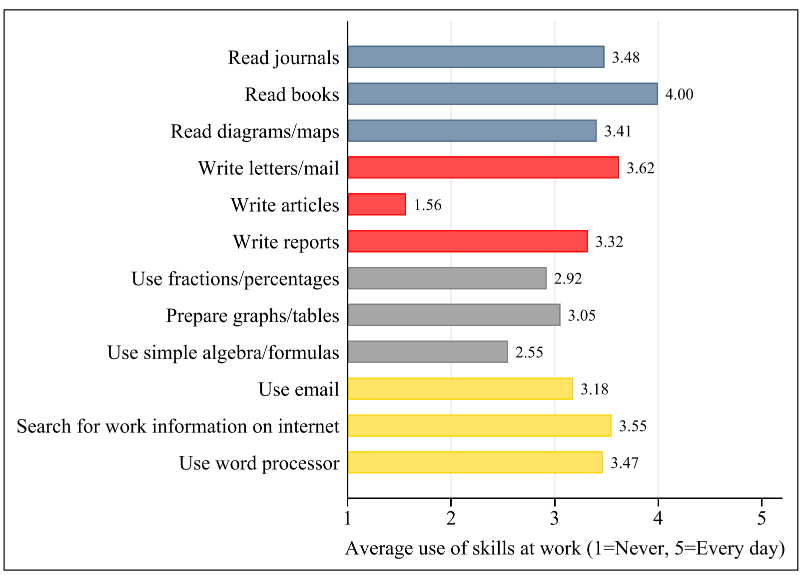

Figure 1 Use of Skills at Work by Teachers in Latin America.

Notes: This figure depicts the average use at work of different skills reported in PIAAC by teachers in Latin America that have a tertiary degree. The sample excludes respondents below age 22, university professors, and other teachers at tertiary-level institutions. Of the 25 skills reported in PIAAC, we selected the ones most relevant to the teaching profession. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight.

7 Neilson, Gallegos and Calle (2019) use long-term data to show that the skill profile of entrants to teacher colleges in Chile has followed a secular decline, which mimics the pattern found in developed countries.

8 In related work, Brunetti et al. (2020) survey a representative sample of primary school teachers in the district of Morazán, El Salvador and find that on average they have low levels of subject knowledge in mathematics. Furthermore, Crawfurd and Pugatch (2020) review related work in mainly low and lower-middle-income countries and find consistent results: teachers tend to have low absolute levels of skills. For example, Bold et al. (2017) document teacher subject knowledge in seven countries in sub-Saharan Africa and find that a large share of primary school teachers in those countries does not have the "minimum knowledge to teach."

9 In comparison to other tertiary educated individuals in Latin America, teachers report to use reading and writing skills more frequently on the job, and numeracy and information and communication technology (ICT) skills less frequently (Appendix Figure A.1).

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The rest of the paper is organized as follows: Section 2 discusses the main features of teacher labor markets in Latin America, Section 3 describes the data, Section 4 presents and discusses the results on skills and selection into teaching, while Section 5 focuses on the relationship between teacher wages and skills. Section 6 concludes.

2 TEACHER LABOR MARKETS

The current stock of teachers is the result of different selection patterns determining who joins and stays in the teaching profession. The institutional features of teacher labor markets play an important role in determining which types of individuals self-select into teaching, pass the screening process, and remain in the profession (Jackson et al. 2014). These features also affect the skill accumulation process toward and during the teaching career. Some of these features include: the mechanisms for attracting and admitting applicants into initial teacher education programs and teaching jobs, the compensation scheme and professional development of teachers throughout their career, and the rules for firing and/or training ineffective teachers. We focus mainly on the institutional features of public school teaching jobs, as the vast majority of teachers in Latin America work in publicly funded schools.[10,11]

Studying to become a teacher. A few studies have documented a negative selection into teaching degrees in terms of skills in Latin America (see Neilson, Gallegos and Calle (2019) on Chile; Elacqua et al. (2018) on Colombia and Chile; de Hoyos, Estrada and Vargas (2018) on Mexico; and Ortega (2010) on Venezuela). This is problematic because teaching degrees are the main pathway to a career in teaching. As seen in Appendix Table A.1, 67 percent of teachers in our sample of Latin American countries have a teaching degree granted by a university or teacher training institution.

The choice of pursuing a teaching degree will likely depend on the prestige, potential earnings, and professional development expected throughout a career in teaching as opposed to alternative professions. Teaching jobs in Latin America have low prestige, have on average low monthly wages in comparison to other jobs with similar education requirements, and have salary schedules that are flat and mostly linked to seniority (Bruns and Luque 2014; Mizala and Ñopo 2016; Elacqua et al. 2018).[12] These low and compressed monthly wages might be an important restriction on attracting more talented people to the teaching profession. However, since teachers work fewer hours on average than other professionals, they tend to have higher hourly wages (see Estrada (2019) on Mexico).[13] Furthermore, several countries in the region have recently improved the working conditions of teachers, increased teacher salaries, and partly linked payment and career progression to performance. Selection into a teaching degree also depends on the financial support offered to students. Successful education systems such as those in Finland, Singapore, and Sweden offer top secondary students who pursue a teaching career free tuition and salary stipends while they are in training (Bruns and Luque 2014), and several countries in Latin America offer merit-based scholarships and/or stipends to teaching students (Elacqua et al. 2018).

The admission policies in universities and teacher training institutions also shape the pool of potential teachers. Unlike many successful education systems, teaching degrees in Latin America do not have strict admission requirements (Elacqua et al. 2018). That said, prospective teaching students in Chile were recently required to score above a threshold in the national university entrance examination, thereby improving the selection into teaching degrees (Neilson et al. 2019).

10 In 2013, for example, over 85 percent of the region's students enrolled in basic education attended public schools (Bruns and Luque 2014).

11 See recent analyses of teacher labor markets in developing countries in World Bank (2018), Beteille and Evans (2019), and Crawfurd and Pugatch (2020). Bruns and Luque (2014) and Elacqua et al., (2018) for a focus in Latin America.

12 Highly compressed and seniority-dependent teacher wages might lead to heterogeneous wage premiums by tenure and skill levels. For example, using a regression discontinuity design, Saavedra et al. (2017) find that novice public school teachers in Colombia have around 65 percent higher annual earnings during their first three years of teaching than applicants who marginally missed the hiring cutoff.

13 Evans et al. (2020) have documented a similar pattern between the hourly and monthly wages of teachers in several African countries.

Although Ecuador and Peru implemented similar policies, they were discontinued shortly thereafter. Prospective teachers enter higher education institutions with a certain set of skills, and these skills are further molded during this educational experience. Although there is little research on the quality of teacher education in Latin America, there is some evidence that teachers acquire fewer skills during tertiary education than students from other disciplines (Balcázar and Ñopo 2016).

Hiring for teaching positions. How education systems attract and select teachers is probably the most important process shaping the stock of teachers. The lack of selectivity in teacher education in Latin America has led to an excess supply of potential teachers (Bruns and Luque 2014). The pool of candidates for teaching positions is even larger, as individuals who hold a non-teaching degree can also apply for teaching jobs, although with some restrictions. Appendix Table A.1 shows that 33 percent of tertiary-educated teachers in Latin America have a non-teaching degree.[14] Given the excess supply of teachers, and the low quality of education granted by many teacher training institutions, adequately screening applicants for teaching jobs is crucial. As teachers in public schools are civil servants with job tenure, hiring mistakes are difficult to reverse. Candidates for teaching positions are typically screened on academic credentials and work experience (Elacqua et al. 2018), even though these characteristics are weakly related to effectiveness in teaching (Hanushek and Rivkin 2010; Rockoff et al. 2011). Opacity over the availability of specific vacancies and wide discretion by education officials over the selection of applicants was considered the norm in most countries. Although it is difficult to identify an effective teacher at the point of entry, there is evidence that teacher effectiveness is related to teachers' cognitive skills (Jacob et al. 2018; Hanushek et al. 2019). Over the last decade, several Latin American countries have started to implement merit-based competitions to recruit new teachers using competency tests (for example Colombia, Ecuador, Mexico, and Peru). Estrada (2019) finds that the implementation of this procedure to hire teachers in Mexico led to higher student learning.

Continuing in the teaching profession. Since teaching skills are also acquired during the first years on the job (Hanushek and Rivkin 2010), screening at the point of entry into the teaching career is necessary but not sufficient. Although most OECD countries have probationary periods for novice teachers, these are rare in Latin America (Bruns and Luque 2014).[15] Removing low-performing teachers later in their career is even harder, as most teachers work in the public sector and cannot be easily fired. It should be noted, however, that a growing number of Latin American countries are reforming their education systems to limit the job security of poorly performing teachers (Bruns and Luque 2014). In addition to the mechanisms for firing low-performing teachers, the skill composition of the teacher pool is also determined by which teachers decide to leave the profession (or stay). Working conditions, pay, and opportunities for professional development will likely have an impact on teacher attrition, particularly in the case of high-skilled teachers who may have more attractive outside options.[16] Selection is not the only channel that shapes the skills profile of teachers. Throughout their careers, teachers can acquire skills through work experience and training. Although there is evidence that teachers acquire teaching-specific skills during their first few years of experience (Hanushek and Rivkin 2010), and participate frequently in in-service training (Popova et al. 2018), there is no evidence on whether they accumulate more or fewer cognitive skills than other professionals.

3 DATA

3.1 THE PIAAC SURVEY

We rely on data from the first cycle of the Survey of Adult Skills, which was conducted in 39 countries in three rounds between 2011 and 2018 as part of PIAAC. This survey measures adults' skills across

14 The self-selection into this alternative pathway to teaching is also shaped by the expected prestige, earnings, and professional development in teaching jobs (Ganimian et al. 2017).

15 Some countries in the region have nominal probationary periods, after which most teachers are automatically hired (Elacqua et al. 2018).

16 The availability of attractive outside options can also affect selection into teaching. Evidence from the US shows that high-skilled individuals have a higher likelihood of choosing teaching over other professions during recessions because of a drop in the expected earnings in alternative occupations (Nagler et al. 2020).

various dimensions and it is designed to produce measures of skills that are comparable across the countries participating in this cycle. The test was designed by an international consortium led by Education Testing Services (ETS), the world's largest private educational testing and measurement organization, with oversight from a board of participating countries and the OECD secretariat. In addition, the survey collects detailed background information on the participants' education and employment history, among other characteristics. A nationally representative sample of individuals ages 16 to 65 is selected in each country, with a minimum sample size of around 5,000 respondents (OECD 2016a). The interviews are conducted by trained enumerators in the respondents' homes.

Respondents are assessed on their proficiency in literacy, numeracy, and problem solving in technology-rich environments. The administration of the test is adaptive and computer-based, although respondents take a paper-based test if they decide to, or if they have insufficient computer experience or skills. Literacy is the ability to understand and use information from written texts in a variety of contexts to achieve goals and develop knowledge and potential, while numeracy is the ability to use, apply, interpret, and communicate mathematical information and ideas.[17] PIAAC provides a snapshot of respondents' numeracy and literacy skills at the moment of the survey. One should take into account, however, that cognitive skills are malleable, and the level of skills possessed at a point in time is the product of the acquisition or depreciation of skills through early childhood experiences, schooling, higher education, and labor market experiences (Behrman et al. 2014).

As participants do not take modules from all the domains assessed and are not assessed using identical items, scores are adjusted using item response theory (IRT) scaling (OECD 2016a).[18] To improve the accuracy of the skills measures, PIAAC uses plausible values, which are multiple imputations obtained by combining the IRT scaling with a latent regression model (Kirsch et al. 2020). Throughout the paper we use the first plausible value of numeracy and literacy scores to produce figures, and the full set of 10 plausible values for the estimation of results reported in tables. Every plausible value provided by PIAAC is an unbiased estimate of individual proficiency in the relevant domain, but the use of the full set of plausible values is necessary to produce correct standard errors that account for imputation in the measurement of proficiency at the individual level (OECD 2016b).

3.2 SAMPLE

Our sample includes the four Latin American countries that participated in PIAAC: Chile, Ecuador, Mexico, and Peru. As a benchmark, our sample also includes the 17 OECD countries with average math and reading PISA scores above the OECD mean in 2015. These are Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Ireland, Japan, the Netherlands, New Zealand, Norway, Poland, Slovenia, South Korea, Sweden, and the United Kingdom. We drop individuals with missing literacy or numeracy scores (1 percent of respondents).

We identify teachers using ISCO occupation codes at the four-digit level (and three-digit when information is available at only this level).[19] We drop employed respondents whose occupation is missing (1.3 percent of the sample). Since our main focus is preschool and K–12 teachers, we exclude university professors and other teachers at tertiary-level institutions. In our main analysis, we compare teachers to non-teachers with similar educational attainment. Since the majority of the teachers in the four Latin American countries in our sample (88 percent) have a tertiary degree, we

17 The assessment on problem solving in technology-rich environments measures the ability to use digital technology, communication tools and networks to acquire and evaluate information, communicate with others, and perform practical tasks (OECD 2016a). Our main analysis focuses only on numeracy and literacy skills because respondents who take the paper-based test do not take the problem-solving assessment. This is the case for 21 percent of the sample of tertiary educated individuals from Latin American countries.

18 Respondents who took the paper-based test were randomly assigned to a module of either literacy or numeracy tasks, whereas those who took the computer-based test took two assessment modules in either one or two of the three domains (literacy, numeracy, and problem solving). The literacy and numeracy modules have 20 tasks each, which are a subset of the total pool of items.

19 Finland, Germany, and Norway use only three-digit occupation codes.

restrict our sample to tertiary-educated individuals (teachers and non-teachers). We further limit our sample to individuals ages 22 and above (98.7 percent of tertiary-educated individuals), and exclude individuals who are not currently employed. This sample has 41,367 observations, of which 11 percent are teachers. Summary statistics for this sample are presented in Panel B of Table 1.

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	MEAN	SD	MIN	MAX	N
Panel A: Tertiary educated sample					
Age	41.138	11.659	22.000	65.000	50,226
Female	0.537	0.499	0.000	1.000	50,226
Literacy score (plausible value 1)	285.533	48.423	36.297	446.448	50,226
Numeracy score (plausible value 1)	283.308	52.539	0.000	466.984	50,226
Non-bachelor's degree	0.331	0.471	0.000	1.000	50,226
Bachelor's degree	0.398	0.490	0.000	1.000	50,226
Master's degree or more	0.271	0.444	0.000	1.000	50,226
Employed	0.836	0.370	0.000	1.000	50,226
Self-employed	0.131	0.337	0.000	1.000	49,636
Teacher	0.105	0.307	0.000	1.000	50,226
Panel B: Employed sample					
Age	40.675	10.952	22.000	65.000	41,367
Female	0.513	0.500	0.000	1.000	41,367
Literacy score (plausible value 1)	287.892	47.434	47.083	446.448	41,367
Numeracy score (plausible value 1)	286.327	51.370	0.000	466.984	41,367
Non-bachelor's degree	0.327	0.469	0.000	1.000	41,367
Bachelor's degree	0.389	0.487	0.000	1.000	41,367
Master's degree or more	0.285	0.451	0.000	1.000	41,367
Self-employed	0.157	0.364	0.000	1.000	40,777
Teacher	0.111	0.315	0.000	1.000	41,367
Hours worked per week	39.327	12.941	1.000	125.000	41,248
Panel C: Wage earners					
Age	39.967	10.658	22.000	65.000	31,191
Female	0.526	0.499	0.000	1.000	31,191
Literacy score (plausible value 1)	291.383	45.899	47.083	446.448	31,191
Numeracy score (plausible value 1)	289.422	50.238	44.162	466.984	31,191
Non-bachelor's degree	0.331	0.471	0.000	1.000	31,191
Bachelor's degree	0.378	0.485	0.000	1.000	31,191
Master's degree or more	0.291	0.454	0.000	1.000	31,191
Teacher	0.126	0.332	0.000	1.000	31,191
Monthly wage (USD PPP)	3,339.317	1,973.321	216.617	20,647.029	31,191
Hours worked per week	40.701	9.199	20.000	125.000	31,191
Wage per hour (USD PPP)	19.221	10.714	0.981	155.987	31,191

Table 1 Summary Statistics.

Notes: Panel A presents descriptive statistics for the sample of PIAAC respondents of age 22 and above with a tertiary degree in Belgium, Canada, Chile, Denmark, Ecuador, Estonia, Finland, France, Germany, Ireland, Japan, Mexico, the Netherlands, New Zealand, Norway, Peru, Poland, Slovenia, South Korea, Sweden, and the United Kingdom. We exclude university professors and other teachers at tertiary-level institutions as well as individuals with missing literacy or numeracy scores. Panel B further restricts the sample to individuals that are employed, and Panel C to wage earners who work 20 or more hours a week, report their monthly income, and are not in the bottom or top 1 percent in their country's wage distribution.

When comparing the skill levels of individuals with a teaching degree to individuals with other tertiary degrees, we rely on the sample of all tertiary educated individuals, regardless of their employment status. This larger sample (50,226 observations) is presented in Panel A of Table 1. Finally, when comparing the wages of teachers and non-teachers, we further restrict our sample of employed individuals to wage earners. This excludes self-employed workers (16 percent of our previous sample). We also exclude individuals with missing monthly wages (4 percent of wage earners), persons who work less than 20 hours a week, and those in the top and bottom 1 percent of each country's wage distribution. The sample of wage earners has 31,191 observations, of which 13 percent are teachers. Panel C of Table 1 describes the main characteristics of this sample.

Appendix Table A.2 details the number of observations and number of teachers in our sample of employed tertiary educated individuals from Latin American countries. While the sample of teachers is relatively small and this is a limitation of this study, Hanushek et al. (2019) show that teacher cognitive skills as measured in PIAAC are very similar to cognitive skills measured in other nationally representative datasets with larger sample sizes, mitigating concerns about the lack of representativeness of this sample.

4 SKILLS AND SELECTION INTO TEACHING

4.1 WHAT SKILLS DO TEACHERS HAVE?

Panel A in Figure 2 shows the density of numeracy scores of tertiary-educated individuals in these Latin American countries by occupation status (teachers and non-teachers). Mere visual inspection indicates that Latin American teachers tend to have low levels of numeracy skills as measured by the PIAAC survey. Teachers in this region have an average numeracy score of 226. For comparison, keep in mind that PIAAC scores are standardized at the international level with a mean of 250 and a SD of 50. That is, even when they are a highly selected group in terms of schooling, Latin American teachers have numeracy scores that are on average 24 percent of a SD lower than the international mean, which includes individuals of all schooling levels. Furthermore, a large share of teachers in Latin America is below basic levels of proficiency. More precisely, 14 percent are below level 1 in the PIAAC proficiency scale, and 50 percent are in level 1 or below (see the areas to the left of the vertical lines). Individuals below proficiency level 1 can most of the time carry out simple processes such as counting, sorting, and performing basic arithmetic operations with whole numbers or money but face difficulties understanding simple percentages such as 50 percent, as shown in Appendix Table A.3. Individuals in proficiency level 1 can mostly understand simple percentages such as 50 percent and perform tasks that require a one-step process, but face difficulties in tasks that require a two-step process involving calculations with whole numbers and common decimals, percentages, and fractions. They also face difficulties understanding basic data and statistics in texts, tables, and graphs (see more about the PIAAC proficiency levels in OECD (2016a)). Summing up, the evidence presented here suggests that at least half of the teachers in Latin America have low absolute levels of cognitive skills, which could compromise their capacity to adequately perform their job.

Teachers' low levels of skills can be thought of as the result of 1) the low level of skills among the population of potential teachers and 2) the skills gap between teachers and the rest of the tertiary-educated population. Figure 2 is a useful starting point to learn about these patterns, as it shows that individuals in Latin America with a tertiary degree working in other professions tend to have lower numeracy scores than the international mean, but they have higher average scores than teachers.

We elaborate on the differences in PIAAC scores between teachers and non-teachers in Table 2, where we report the results from regressing numeracy and literacy scores on an indicator for whether the respondent works as a teacher and on country fixed effects. The point estimates indicate that the numeracy and literacy scores of teachers in Latin America are 7.7 and 4.07 points lower, respectively, on average than those of tertiary-educated individuals working in other professions. However, only the difference in numeracy is statistically significant (at the 5 percent level). The numeracy skills gap is equivalent to 15.4 percent of a SD.

We also examine differences in the share of teachers and non-teachers at different proficiency levels. We should note, however, that differences across subgroups in the share of individuals at a certain proficiency level are dependent on the test score distribution and the defined proficiency-level cutoff (Ho 2008). This dependency can be problematic if the shape of the test score distribution differs significantly by subgroup; in that case, the gap between subgroups in the share of individuals below a given cutoff will vary across the test score distribution. This concern is less problematic in our context, as there appears to be a gap between the share of teachers and non-teachers throughout the lower part of the distribution of skills, as shown in Figures 2 and A.2. Nonetheless, it is important to interpret these results together with those analyzing differences in continuous measures of test scores—as those presented in the first two columns of Table 2. As shown in Table 2, teachers are 7.7 and 3.7 percentage points more likely than non-teachers to have a numeracy and literacy score in proficiency level 1 or below ("Low Score"). Although, again, only the gap in numeracy is statistically

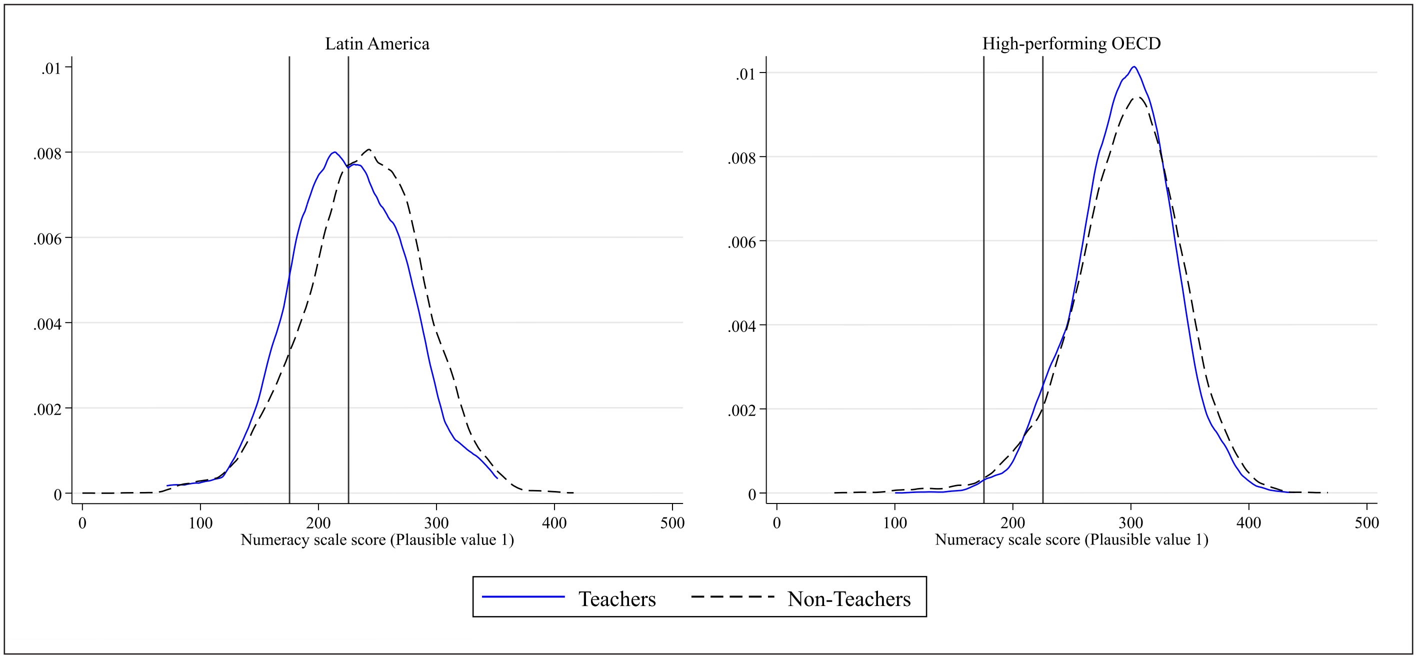

Figure 2 Density of Numeracy Scores: Teachers and Non-Teachers.

Notes: These figures depict the kernel density of numeracy scores (first plausible value) for both teachers and non-teachers that have a tertiary degree and are employed. The sample excludes respondents below age 22, university professors, and other teachers at tertiary-level institutions. The first graph plots these densities for respondents from Latin America, whereas the second plots these densities for respondents from OECD-countries with average math and reading PISA scores above the OECD mean in 2015. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. The vertical lines mark the cutoffs for the proficiency levels below 1 and 1.

	SCORE		LOW SCORE		HIGH SCORE	
	NUMERACY	LITERACY	NUMERACY	LITERACY	NUMERACY	LITERACY
Panel A: Latin America						
Teacher	–7.749**	–4.073	0.077*	0.037	–0.010	–0.007
	(3.462)	(3.640)	(0.042)	(0.036)	(0.013)	(0.013)
Observations	3,778	3,778	3,778	3,778	3,778	3,778
Observations (teachers)	504	504	504	504	504	504
R^2	0.080	0.111	0.060	0.084	0.011	0.010
Dependent variable mean	236.195	240.641	0.398	0.364	0.031	0.026
Panel B: High-performing OECD						
Teacher	–3.236***	0.413	–0.007	–0.014***	–0.052***	–0.023**
	(1.046)	(0.861)	(0.006)	(0.005)	(0.010)	(0.011)
Observations	37,589	37,589	37,589	37,589	37,589	37,589
Observations (teachers)	3,930	3,930	3,930	3,930	3,930	3,930
R^2	0.046	0.039	0.018	0.012	0.030	0.028
Dependent variable mean	296.772	297.755	0.063	0.050	0.258	0.245
P-value (Latin America = OECD)	0.230	0.245	0.048	0.160	0.011	0.371

Table 2 PIAAC Scores: Teachers and Non-Teachers.

Notes: The sample in Panel A is composed of PIAAC respondents ages 22 and above from Latin America that have a tertiary degree and are employed. We exclude university professors and other teachers at tertiary-level institutions. Panel B contains the analogous sample for OECD countries with average math and reading PISA scores above the OECD mean in 2015. This table presents the results of regressions where the independent variables are country fixed effects and a dummy for whether the respondent is a teacher. The dependent variables in columns 1 and 2 are the numeracy and literacy scores, respectively. The dependent variable in columns 3 and 4 is a dummy for whether the respondent scored below proficiency level 2 in numeracy and literacy, respectively. The dependent variable in columns 5 and 6 is a dummy for whether the respondent scored at level 4 or above. We compute these estimates using the *repest* command in Stata, which allows to use the full set of plausible values and to compute appropriate standard errors. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. * significant at 10%; ** significant at 5%; *** significant at 1%.

significant (at the 10 percent level). In contrast, there is no clear gap in the probability of attaining a score in proficiency level 4 or above ("High Score"). The coefficients of interest for both numeracy and literacy scores have a negative sign, but are not statistically significant.[20]

In the high-performing OECD countries, the point estimate of the difference between the average numeracy score of teachers and non-teachers is smaller (-3.2 points), but we cannot reject the null hypothesis that this gap is the same as the one in Latin America. Interestingly, teachers are 0.7–1.4 percentage points less likely to have low scores in numeracy and literacy skills (only the second is statistically significant), but are also less likely to have a high score (by around 5 percentage points in numeracy and 2 percentage points in literacy). In other words, in these OECD countries, the distribution of PIAAC scores is more compressed among teachers than among non-teachers.

Summing up, we document that a large share of teachers in Latin America have low levels of cognitive skills and that teachers tend to have lower levels of numeracy skills than individuals with similar schooling levels (i.e., a teacher skills gap).

We conduct the same analysis using scores in problem-solving in technology-rich environments, and present the results in Appendix Table A.10. We find that many respondents from Latin America have low scores in this domain. In particular, 42 percent score below proficiency level 1, and 46 percent score below level 1 if we include respondents who took the paper-based test because of their limited computer skills (there are only four proficiency levels in this domain, as opposed to six numeracy and literacy). While teachers have lower scores than non-teachers (6.4 points out of a mean of 259), this difference is not statistically significant.

4.2 WHAT SELECTION PATTERNS COULD EXPLAIN THE TEACHER SKILLS GAP?

What are the skills of those who study teaching? As obtaining a teaching degree is the main path to a teaching career (Section 2), it seems natural to ask if there is a skills gap between the individuals who pursue a teaching degree and those who pursue another tertiary degree.[21] With this purpose in mind, Figure 3 plots the density of numeracy scores for both groups (see the figure to the left for Latin American countries and the one in the right for the high-performing OECD countries). Visual inspection suggests that there is a large skills gap in Latin America, which we confirm in Table 3 with regression estimates. Individuals in Latin America with a teaching degree have numeracy and literacy scores that are 14.4 and 11.5 points lower on average than individuals with other tertiary degrees—or 29 and 23 percent of a SD. Furthermore, teaching graduates are 11 and 8 percentage points more likely, respectively, to have a low score in literacy and numeracy and 2 percent less likely to have a high score in literacy and numeracy. Most of these results are statistically significant at the 1 percent level.[22] These findings are consistent with those from Neilson et al. (2019) on Chile; Elacqua et al. (2018) on Colombia and Chile; de Hoyos, Estrada and Vargas (2018) on Mexico; and Ortega (2010) on Venezuela. These studies document that compared to university students enrolled in other majors, students enrolled in education majors have lower numeracy and literacy scores on average in the national standardized exams that students take at the end of secondary school.

In the OECD countries, teaching graduates also have lower average numeracy and literary scores than other tertiary graduates (by 8.5 and 4.2 points, respectively), but these differences are statistically smaller than those observed in Latin America. Teaching graduates in the OECD countries are also less likely to have a high score in both domains (by 9 and 5 percentage points, respectively). We do not observe a difference on the probability of having low scores in numeracy and literacy.

The skills gap in Latin America between teaching graduates and other tertiary graduates seems larger than the gap between actual teachers and non-teachers with tertiary studies. This suggests

20 Tables A.4 and A.5 in the Appendix show results using all tertiary educated individuals as the comparison group and restricting the sample to wage earners (83 percent of teachers in the sample are salaried workers), respectively. See results at the country level in Appendix Tables A.6–A.9.

21 We identify respondents with a teaching degree using the ISCED Broad Fields of Education and Training. We consider that a respondent has a teaching degree if the area of study in his/her highest qualification is teacher training and education science.

22 Our findings on the skills gap between teachers and non-teachers, and individuals with and without a teaching degree are very similar if we exclude early childhood educators from our sample, as shown in Appendix Table A.11.

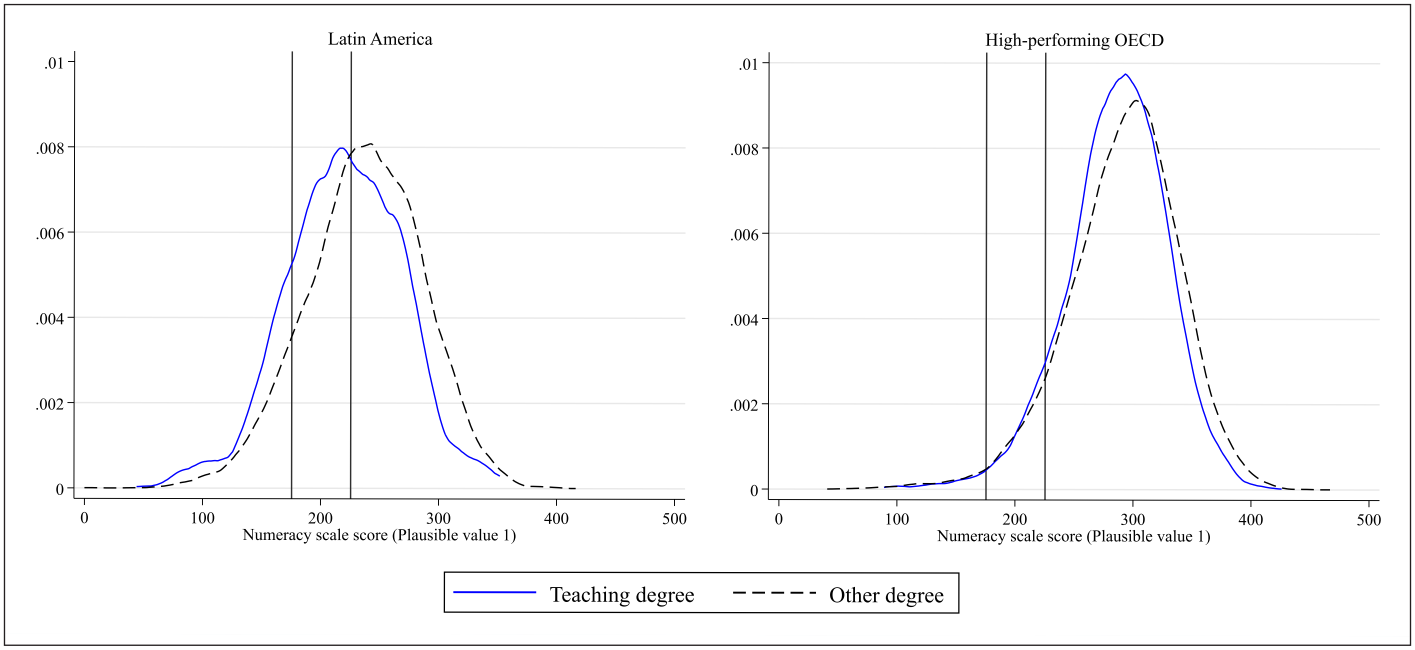

Figure 3 Density of Numeracy Scores: Teaching Degrees and Non-Teaching Degrees.

Notes: These figures depict the kernel density of numeracy scores (first plausible value) for individuals with tertiary teaching and non-teaching degrees. The sample excludes respondents below the age of 22, university professors, and other teachers at tertiary-level institutions. The first graph plots these densities for respondents from Latin America, whereas the second plots these densities for respondents from OECD-countries with average math and reading PISA scores above the OECD mean in 2015. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. The vertical lines mark the cutoffs for the proficiency levels below 1 and 1.

	SCORE		LOW SCORE		HIGH SCORE	
	NUMERACY	LITERACY	NUMERACY	LITERACY	NUMERACY	LITERACY
Panel A: Latin America						
Teaching degree	–14.444***	–11.560***	0.115***	0.078***	–0.018*	–0.018*
	(2.570)	(2.722)	(0.028)	(0.030)	(0.010)	(0.009)
Observations	4,511	4,511	4,511	4,511	4,511	4,511
Observations (teaching degree)	798	798	798	798	798	798
R^2	0.098	0.124	0.074	0.095	0.012	0.011
Dependent variable mean	234.002	239.201	0.414	0.377	0.029	0.026
Panel B: High-performing OECD						
Teaching degree	–8.495***	–4.185***	0.006	–0.002	–0.088***	–0.053***
	(0.909)	(0.814)	(0.005)	(0.004)	(0.009)	(0.010)
Observations	45,715	45,715	45,715	45,715	45,715	45,715
Observations (teaching degree)	5,610	5,610	5,610	5,610	5,610	5,610
R^2	0.045	0.038	0.016	0.010	0.032	0.030
Dependent variable mean	293.742	295.207	0.075	0.061	0.242	0.232
P-value (Latin America = OECD)	0.025	0.010	0.000	0.006	0.000	0.018

Table 3 PIAAC Scores: Teaching Degrees and Non-Teaching Degrees.

Notes: The sample in Panel A is composed of PIAAC respondents ages 22 and above from Latin America that have a tertiary degree. We exclude university professors and other teachers at tertiary-level institutions. Panel B contains the analogous sample for the OECD countries with average math and reading PISA scores above the OECD mean in 2015. This table presents the results of regressions where the independent variables are country fixed effects and a dummy for whether the respondent has a teaching degree. The dependent variables in columns 1 and 2 are the numeracy and literacy scores, respectively. The dependent variable in columns 3 and 4 is a dummy for whether the respondent scored below proficiency level 2 in numeracy and literacy, respectively. The dependent variable in columns 5 and 6 is a dummy for whether the respondent scored at level 4 or above. We compute these estimates using the *repest* command in Stata, which allows to use the full set of plausible values and to compute appropriate standard errors. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. * significant at 10%; ** significant at 5%; *** significant at 1%.

that there might be some selection patterns in the education system that mitigate the negative selection in terms of skills into obtaining a teaching degree. Part of this gap could also be explained by the lower accumulation of cognitive skills in teaching degrees compared to other tertiary degrees (Balcázar and Ñopo 2016).

What are the skills of those who study teaching and become teachers? Figure 4 plots the density of numeracy scores of teaching graduates by whether they work as teachers or not, while Table 4 reports the corresponding regression results. The point estimates indicate that teachers with a teaching degree have average numeracy and literacy scores that are around 4 points (0.08 SD) higher than non-teachers with a teaching degree. However, standard errors are large and these differences are not statistically significant (the sample is considerably smaller than in the previous tables).

In the high-performing OECD countries there is a clear positive selection into working as a teacher. Among teaching degree graduates, individuals with a teaching occupation tend to perform better in the numeracy and literacy domains than non-teachers. However, we cannot reject that this pattern of selection is the same as in Latin America.

In summary, the evidence presented here indicates that among teaching-degree graduates in Latin America, there might be some but not much positive selection on skills into entering and staying in the education system.

Is there a skills gap between teachers who studied teaching and other teachers? A teaching degree is the main pathway to becoming a teacher, but it is not the only one. Around one third of teachers in our sample of Latin American countries have non-teaching degrees. So, it seems natural to ask if there is a skills gap between these two types of teachers. Figure 5 shows the density of numeracy scores for both groups. Teachers with a teaching degree in Latin America seem to have lower numeracy scores on average than other teachers. Table 5 presents the corresponding regression estimates. The point estimates indicate that Latin American teachers with a teaching degree have substantially lower numeracy and literacy scores than teachers with other degrees, by 13 and 11 points, or 26 and 22 percent of a SD, respectively, although only the numeracy gap is statistically significant (at the five percent level). These differences are driven by the lower end of the distribution, as teachers are 12 and 8 percentage points, respectively, more likely to have low numeracy and literacy scores (only the first result is statistically significant), but do not differ in the probability of having a high score.[23]

The skills profiles of both groups of teachers are less dissimilar in the OECD countries (although point estimates are noisy and we cannot reject the null hypothesis of equality with Latin America). Teaching degree graduates' numeracy and literacy scores are 5 and 3 points lower, on average, or 9 and 7 percent of a SD, respectively. Unlike the case of Latin America, these differences are found at the top of the distribution, as teachers with a teaching degree are 5 and 3 percentage points less likely to have a high score in numeracy and literacy, respectively, compared to teachers with other degrees.

The selection of individuals with non-teaching degrees improves the composition of the stock of teachers in Latin America in terms of cognitive skills (although the results for literacy are noisily estimated). This is not an obvious result, even if non-teaching graduates have higher skills on average than teaching graduates, because it depends on how teachers are selected among the pool of individuals with non-teaching degrees.

What are the skills of those who did not study teaching and become teachers? We finally look at where teachers without a teaching degree are located in the skills distribution of non-teaching graduates. Figure 6 and Table 6 show this comparison. The skill distribution of individuals with a non-teaching tertiary degree who work as teachers in Latin America is similar to the one of those who do not work as teachers. That is, we do not find any selection pattern in terms of skills into teaching among those who did not study teaching during their tertiary education. The pattern is similar in the high-performing OECD countries, although the skills distribution of teachers seems more compressed than that of non-teachers.

23 As shown in Appendix Table A.1, teachers with a non-teaching degree are more likely to teach in secondary school. If we compare individuals who teach in the same schooling level, the differences are smaller, although the general pattern still holds (see Table A.12 in the Online Appendix).

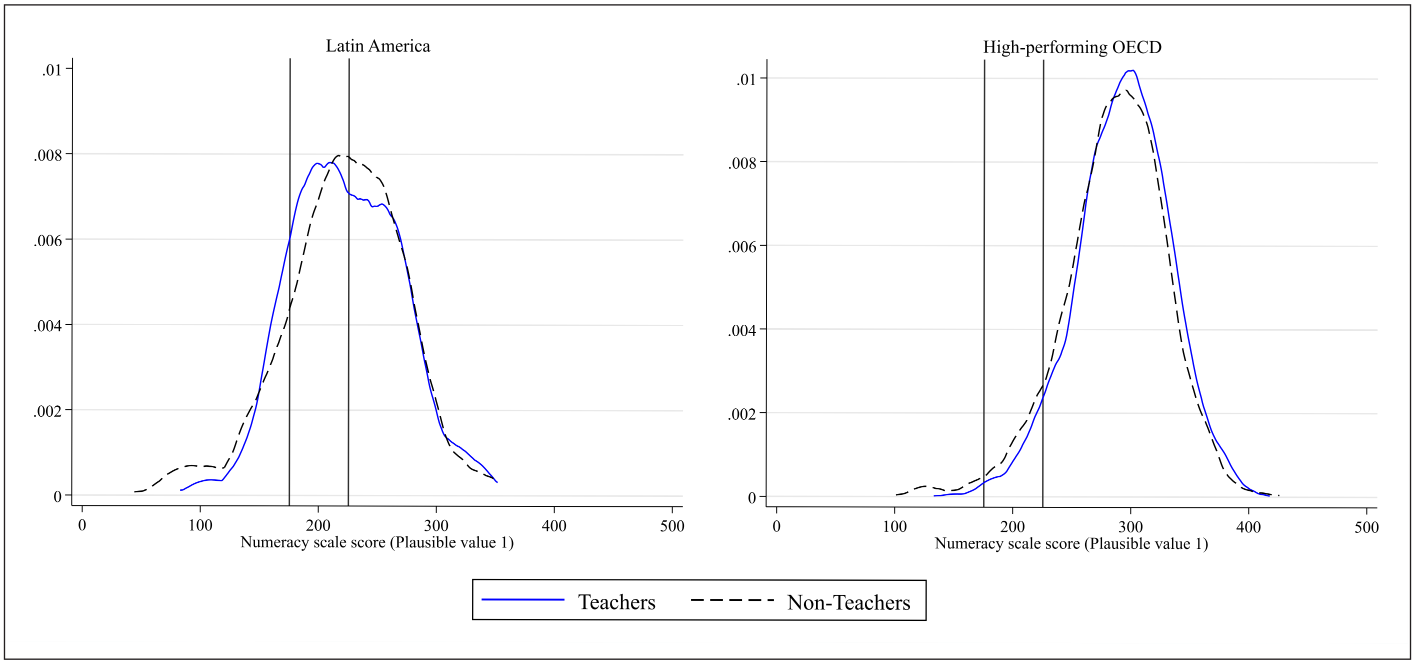

Figure 4 Density of Numeracy Scores: Teachers and Non-Teachers with Teaching Degrees.

Notes: These figures depict the kernel density of numeracy scores (first plausible value) for employed teachers and non-teachers with a tertiary teaching degree. The sample excludes respondents below the age of 22, university professors, and other teachers at tertiary-level institutions. The first graph plots these densities for respondents from Latin America, whereas the second plots these densities for respondents from OECD-countries with average math and reading PISA scores above the OECD mean in 2015. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. The vertical lines mark the cutoffs for the proficiency levels below 1 and 1.

	SCORE		LOW SCORE		HIGH SCORE	
	NUMERACY	LITERACY	NUMERACY	LITERACY	NUMERACY	LITERACY
Panel A: Latin America						
Teacher	3.930	4.023	–0.003	0.001	–0.000	0.001
	(5.468)	(4.420)	(0.066)	(0.052)	(0.017)	(0.014)
Observations	671	671	671	671	671	671
Observations (teachers)	367	367	367	367	367	367
R^2	0.098	0.109	0.059	0.089	0.016	0.019
Dependent variable mean	221.929	229.268	0.518	0.443	0.013	0.010
Panel B: High-performing OECD						
Teacher	6.729***	6.405***	–0.029**	–0.022**	0.030	0.037**
	(1.819)	(1.591)	(0.011)	(0.010)	(0.019)	(0.019)
Observations	4,513	4,513	4,513	4,513	4,513	4,513
Observations (teachers)	2,458	2,458	2,458	2,458	2,458	2,458
R^2	0.057	0.054	0.025	0.016	0.026	0.036
Dependent variable mean	290.879	295.324	0.063	0.044	0.191	0.204
P-value (Latin America = OECD)	0.633	0.615	0.803	0.824	0.205	0.109

Table 4 PIAAC Scores: Teachers and Non-Teachers with Teaching Degrees.

Notes: The sample in Panel A is composed of PIAAC respondents ages 22 and above from Latin America that have a tertiary teaching degree and are employed. We exclude university professors and other teachers at tertiary-level institutions. Panel B contains the analogous sample for the OECD countries with average math and reading PISA scores above the OECD mean in 2015. This table presents the results of regressions where the independent variables are country fixed effects and a dummy for whether the respondent is a teacher. The dependent variables in columns 1 and 2 are the numeracy and literacy scores, respectively. The dependent variable in columns 3 and 4 is a dummy for whether the respondent scored below proficiency level 2 in numeracy and literacy, respectively. The dependent variable in columns 5 and 6 is a dummy for whether the respondent scored at level 4 or above. We compute these estimates using the *repest* command in Stata, which allows to use the full set of plausible values and to compute appropriate standard errors. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. * significant at 10%; ** significant at 5%; *** significant at 1%.

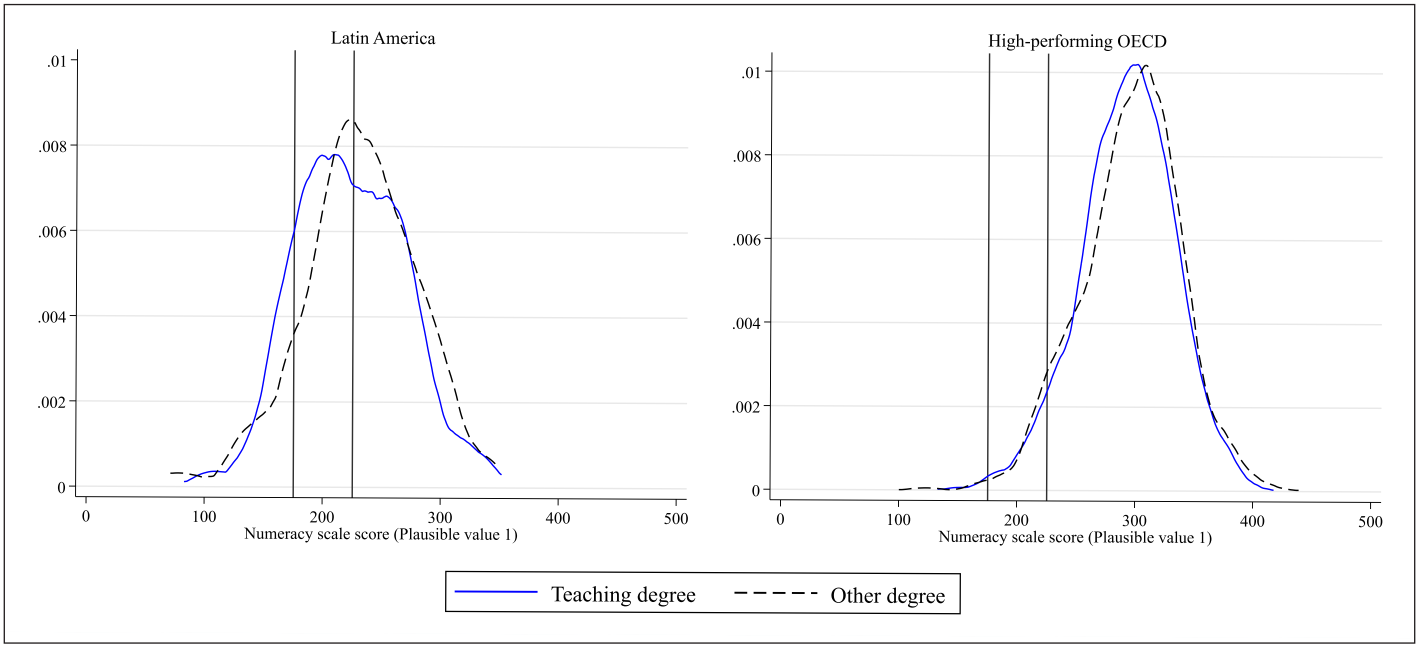

Figure 5 Density of Numeracy Scores: Teachers with Teaching and Non-Teaching Degrees.

Notes: These figures depict the kernel density of numeracy scores (first plausible value) for teachers with tertiary teaching and non-teaching degrees. The sample excludes respondents below the age of 22, university professors, and other teachers at tertiary-level institutions. The first graph plots these densities for respondents from Latin America, whereas the second plots these densities for respondents from OECD-countries with average math and reading PISA scores above the OECD mean in 2015. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. The vertical lines mark the cutoffs for the proficiency levels below 1 and 1.

	SCORE		LOW SCORE		HIGH SCORE	
	NUMERACY	LITERACY	NUMERACY	LITERACY	NUMERACY	LITERACY
Panel A: Latin America						
Teaching degree	–13.208**	–11.352	0.120*	0.081	–0.021	–0.022
	(6.584)	(7.385)	(0.069)	(0.074)	(0.022)	(0.036)
Observations	504	504	504	504	504	504
Observations (teaching degree)	367	367	367	367	367	367
R^2	0.126	0.111	0.081	0.074	0.027	0.030
Dependent variable mean	225.715	233.109	0.495	0.429	0.017	0.016
Panel B: High-performing OECD						
Teaching degree	–4.652**	–3.376*	–0.004	0.002	–0.052**	–0.033*
	(1.810)	(1.894)	(0.011)	(0.009)	(0.021)	(0.020)
Observations	3,930	3,930	3,930	3,930	3,930	3,930
Observations (teaching degree)	2,458	2,458	2,458	2,458	2,458	2,458
R^2	0.062	0.057	0.024	0.013	0.033	0.038
Dependent variable mean	295.068	298.349	0.053	0.036	0.220	0.224
P-value (Latin America = OECD)	0.229	0.308	0.075	0.280	0.287	0.776

Table 5 PIAAC Scores: Teachers with Teaching Degrees and Non-Teaching Degrees.

Notes: The sample in Panel A is composed of PIAAC respondents ages 22 and above from Latin America that have a tertiary degree and are employed as teachers. We exclude university professors and other teachers at tertiary-level institutions. Panel B contains the analogous sample for the OECD countries with average math and reading PISA scores above the OECD mean in 2015. This table presents the results of regressions where the independent variables are country fixed effects and a dummy for whether the respondent has a teaching degree. The dependent variables in columns 1 and 2 are the numeracy and literacy scores, respectively. The dependent variable in columns 3 and 4 is a dummy for whether the respondent scored below proficiency level 2 in numeracy and literacy, respectively. The dependent variable in columns 5 and 6 is a dummy for whether the respondent scored at level 4 or above. We compute these estimates using the *repest* command in Stata, which allows to use the full set of plausible values and to compute appropriate standard errors. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. * significant at 10%; ** significant at 5%; *** significant at 1%.

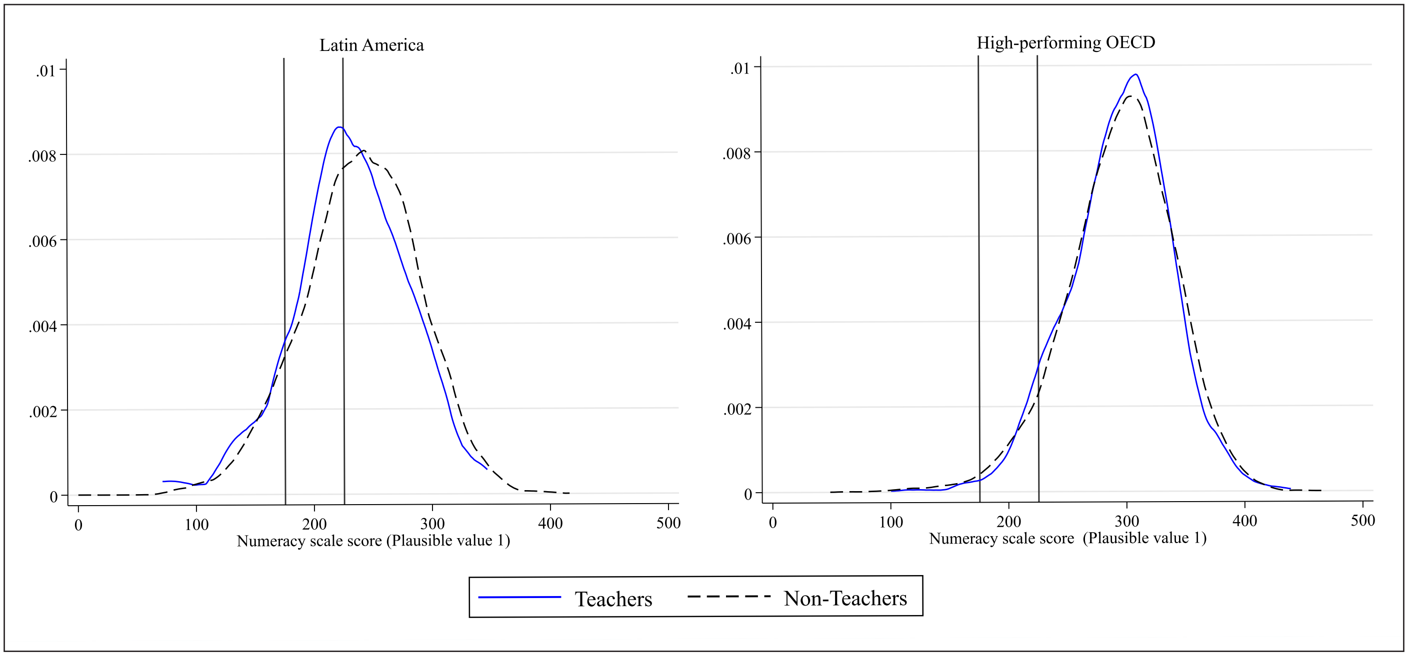

Figure 6 Density of Numeracy Scores: Teachers and Non-Teachers with Non-Teaching Degrees.

These figures depict the kernel density of numeracy scores (first plausible value) for employed teachers and non-teachers with a non-teaching tertiary degree. The sample excludes respondents below the age of 22, university professors, and other teachers at tertiary-level institutions. The first graph plots these densities for respondents from Latin America, whereas the second plots these densities for respondents from OECD-countries with average math and reading PISA scores above the OECD mean in 2015. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. The vertical lines mark the cutoffs for the proficiency levels below 1 and 1.

	SCORE		LOW SCORE		HIGH SCORE	
	NUMERACY	LITERACY	NUMERACY	LITERACY	NUMERACY	LITERACY
Panel A: Latin America						
Teacher	–2.202	2.044	0.023	–0.013	0.002	0.006
	(5.827)	(6.827)	(0.069)	(0.069)	(0.017)	(0.032)
Observations	3,101	3,101	3,101	3,101	3,101	3,101
Observations (teachers)	137	137	137	137	137	137
R^2	0.070	0.108	0.055	0.081	0.011	0.010
Dependent variable mean	239.038	242.889	0.374	0.348	0.035	0.030
Panel B: High-performing OECD						
Teacher	–0.537	2.348	–0.001	–0.012*	–0.017	–0.001
	(1.594)	(1.496)	(0.009)	(0.007)	(0.016)	(0.016)
Observations	32,755	32,755	32,755	32,755	32,755	32,755
Observations (teachers)	1,460	1,460	1,460	1,460	1,460	1,460
R^2	0.049	0.040	0.016	0.011	0.032	0.030
Dependent variable mean	298.172	298.677	0.059	0.047	0.268	0.252
P-value (Latin America = OECD)	0.791	0.966	0.724	0.999	0.416	0.844

Table 6 PIAAC Scores: Teachers and Non-Teachers with Non-Teaching Degrees.

Notes: The sample in Panel A is composed of PIAAC respondents ages 22 and above from Latin America that have a non-teaching tertiary degree and are employed. We exclude university professors and other teachers at tertiary-level institutions. Panel B contains the analogous sample for the OECD countries with average math and reading PISA scores above the OECD mean in 2015. This table presents the results of regressions where the independent variables are country fixed effects and a dummy for whether the respondent is a teacher. The dependent variables in columns 1 and 2 are the numeracy and literacy scores, respectively. The dependent variable in columns 3 and 4 is a dummy for whether the respondent scored below proficiency level 2 in numeracy and literacy, respectively. The dependent variable in columns 5 and 6 is a dummy for whether the respondent scored at level 4 or above. We compute these estimates using the *repest* command in Stata, which allows to use the full set of plausible values and to compute appropriate standard errors. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. * significant at 10%; ** significant at 5%; *** significant at 1%.

5 SKILLS AND TEACHER WAGES

Is the teacher wage gap explained by the skills gap? Several studies have documented that teachers tend to have lower monthly wages than tertiary-educated individuals working in other occupations, although this is not necessarily the case if one looks at hourly wages (Section 2). However, as such wages gaps are generally estimated using regressions in which researchers control for the observable characteristics available in labor force surveys (typically gender, age, and schooling), it is not clear whether these differences still hold after taking into account the teacher skills gap.

Figure 7 shows the monthly wage distribution by occupation status (teachers and non-teachers) for the Latin American and high-performing OECD countries. In Latin America, the distribution of teachers' monthly salaries is more compressed than the wage distribution of non-teachers, and a larger part of the mass seems to be located further to the left. This wage compression is consistent with the institutional features that shape teachers' labor market in Latin America (Section 2). In contrast, in the OECD countries the difference in the wage distribution by occupation status is less startling.

Panel A in Table 7 shows the regression estimates of the average gap in monthly wages (in ln) between teachers and non-teachers. We express wages in natural logs so as to reduce the importance of outliers, and to ease the interpretation of our estimates, which can be interpreted as approximate proportional changes. Controlling for gender, age, schooling, country fixed effects, the average wages of teachers in Latin America are about 17 percent lower than non-teachers, and about 14 percent lower once we control for numeracy and literacy scores. Both results are statistically significant at the 1 percent level. Hence, the teacher wage gap persists even if one takes cognitive skills—as measured by the PIAAC survey—into account. In contrast, the estimates of the teacher (monthly) wage gap in the OECD countries amount to around 3 percent.

Panel B reports the estimated gap in hourly wages between teachers and non-teachers. Controlling for baseline characteristics, the average hourly wage of teachers in Latin America is around 4 percent higher than that of non-teachers (column 1), though not significant. Including our measures of skills increases the magnitude of the coefficient to around 7 percent (with significance at the 5 percent level) (column 2). The teacher wage gap in high-performing OECD countries is of around 2 percent (columns 3 and 4), with and without controlling for skills.

Hence, the pattern of teachers' lower monthly wages and higher hourly wages still holds when controlling for numeracy and literacy skills. It is not obvious, however, whether these differences are constant along the skills distribution is not immediately apparent.

Do teachers with more skills have higher wages? Panel A of Table 8 shows the partial correlation between monthly wages and the PIAAC numeracy score for teachers and non-teachers. Controlling for age, gender, schooling, and country fixed effects, the relationship between numeracy skills and wages is twice as large for non-teachers compared to teachers in Latin America. We find a very similar pattern when examining the relationship between literacy skills and wages (see Appendix Table A.13). We find a similar relationship in the OECD countries. These patterns are similar when examining the relationship between hourly wages and skills (see Panel B of Tables 8 and A.13). To better illustrate this point, Figures 8 and A.7 provide the visual counterpart to the full regression model in Panel A of Tables 8 and A.13. Summing up, teachers' relative wages decrease with skills, both for monthly and hourly wages. In other words, teacher labor markets reward skills less than the markets for other professionals.

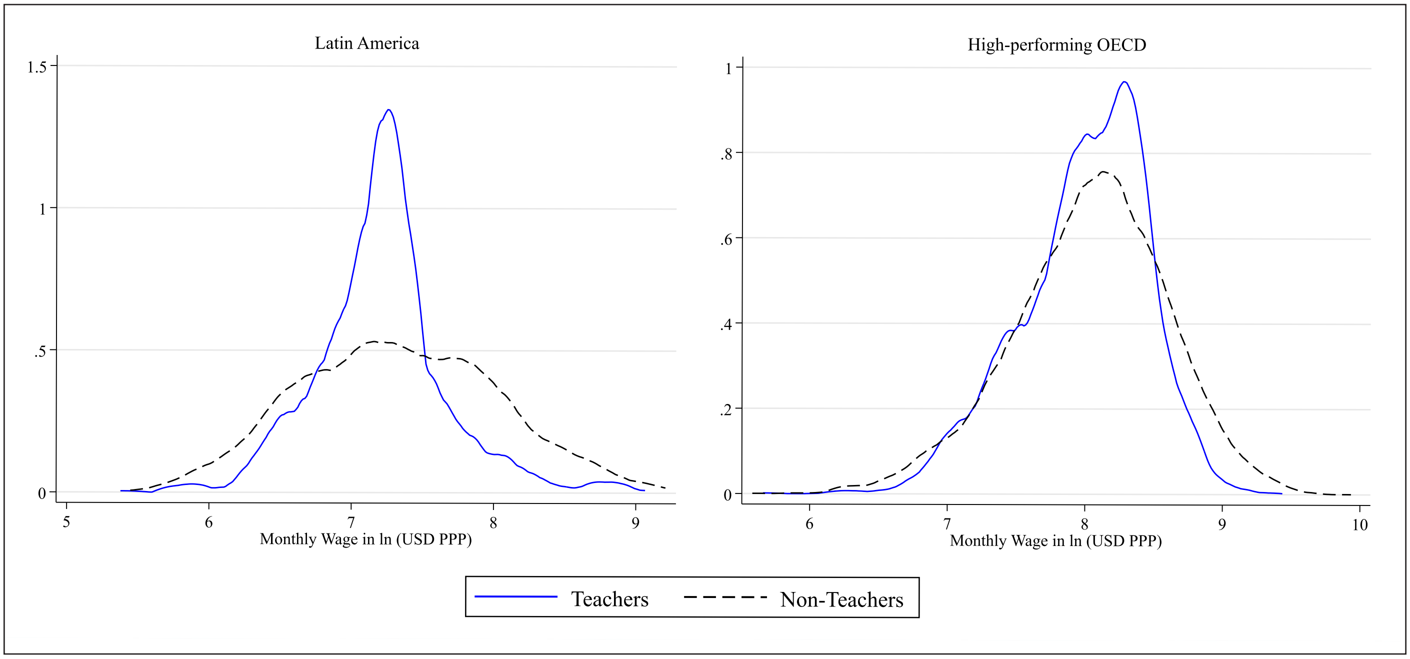

Figure 7 Density of Monthly Wages (in ln): Teachers and Non-Teachers.

Notes: These figures depict the kernel density of monthly wages (in ln) for teachers and non-teachers ages 22 and above with a tertiary degree. The first graph plots these densities for respondents from Latin America, whereas the second plots these densities for respondents from OECD-countries with average math and reading PISA scores above the OECD mean in 2015. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. The sample in both graphs is limited to wage earners that are currently employed, work 20 or more hours a week, and are not in the bottom or top 1 percent of their country's wage distribution. We also exclude university professors and other teachers at tertiary-level institutions.

	LATIN AMERICA		HIGH-PERFORMING OECD	
	(1)	(2)	(3)	(4)
Panel A: Monthly wages (in ln)				
Teacher	−0.170***	−0.140***	−0.032***	−0.032***
	(0.036)	(0.038)	(0.008)	(0.008)
Observations	2,282	2,282	28,909	28,909
R^2	0.311	0.336	0.409	0.449
Panel B: Hourly wages (in ln)				
Teacher	0.046	0.074**	0.018**	0.018**
	(0.034)	(0.036)	(0.007)	(0.007)
Observations	2,282	2,282	28,909	28,909
R^2	0.289	0.310	0.445	0.482
Age, gender, and schooling controls	✓	✓	✓	✓
Literacy and numeracy scores		✓		✓

Table 7 Wages: Teachers and Non-Teachers.

Notes: Panel A presents the results of regressions where the dependent variable is the respondent's monthly wage (in ln). In Panel B, the dependent variable is the respondent's hourly wage. The regressions in columns (1) and (3) include country fixed effects, age, age squared, gender, and dummies for whether the respondent has a bachelor's or master's degree or higher. The regressions in columns (2) and (4) also control for the respondent's numeracy and literacy scores. We compute these estimates using the *repest* command in Stata, which allows to use the full set of plausible values and to compute appropriate standard errors. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. The regressions in columns 1 and 2 are conducted for the sample of PIAAC respondents from Latin America that are ages 22 and above and have a tertiary education, are wage earners, are currently employed, work 20 or more hours a week, and are not in the bottom or top 1 percent of their country's wage distribution. We exclude university professors and other teachers at tertiary-level institutions. The regressions in columns 3 and 4 are conducted for the analogous sample in the OECD countries with average math and reading PISA scores above the OECD mean in 2015. * significant at 10%; ** significant at 5%; *** significant at 1%.

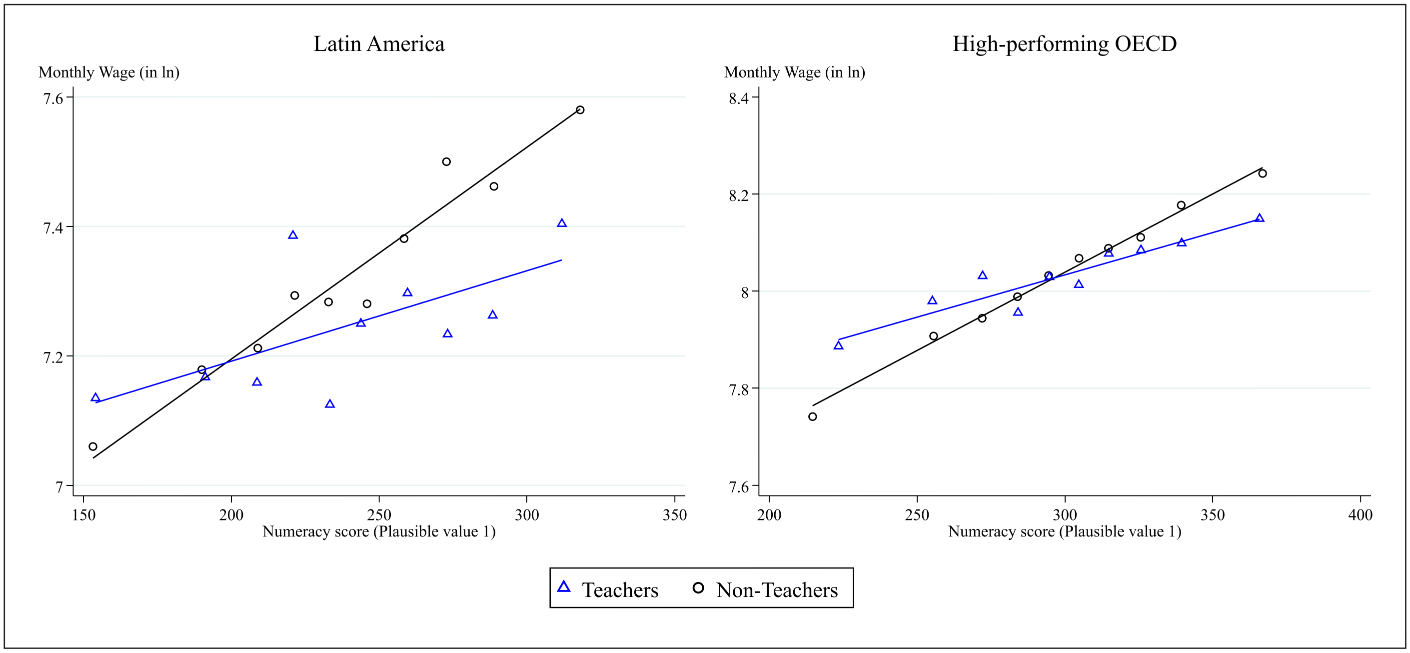

Figure 8 Local Means of Monthly Wages by PIAAC Numeracy Score: Teachers and Non-Teachers.

Notes: These figures plot the monthly wages (in ln) against average numeracy scores (first plausible value) for teachers and non-teachers with a tertiary degree. The lines plot the predicted values of a linear regression controlling for gender, age, age squared, and country fixed effects. The triangles plot the average residuals (with the mean added back) of a regression of monthly wages (in ln) against gender, age, age squared, and country fixed effects. These means are computed for equal-sized bins of numeracy scores. The sample in the first graph is composed of respondents from Latin America and the second of respondents from OECD-countries with average math and reading PISA scores above the OECD mean in 2015. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. The sample in both graphs is limited to respondents ages 22 or above that are wage earners, are currently employed, work 20 or more hours a week, and are not in the bottom or top 1 percent of their country's wage distribution. We also exclude university professors and other teachers at tertiary-level institutions. This figure was constructed using the *binscatter* command.

	LATIN AMERICA		HIGH-PERFORMING OECD	
	TEACHERS	NON-TEACHERS	TEACHERS	NON-TEACHERS
Panel A: Monthly wages (in ln)				
Numeracy score	0.0013**	0.0023***	0.0012***	0.0027***
	(0.0006)	(0.0004)	(0.0002)	(0.0001)
Observations	419	1,863	3,282	25,627
R^2	0.234	0.353	0.618	0.444
Panel B: Hourly wages (in ln)				
Numeracy score	0.0010*	0.0021***	0.0006***	0.0025***
	(0.0006)	(0.0005)	(0.0002)	(0.0001)
Observations	419	1,863	3,282	25,627
R^2	0.275	0.329	0.609	0.482
Age, gender, and schooling controls	✓	✓	✓	✓

Table 8 Wages and Numeracy Skills: Teachers and Non-Teachers.

Notes: Panel A presents the results of regressions where the dependent variable is the respondent's monthly wage (in ln). In Panel B, the dependent variable is the respondent's hourly wage. All regressions include country fixed effects and the variables for which estimates are reported. We compute these estimates using the *repest* command in Stata, which allows to use the full set of plausible values and to compute appropriate standard errors. We use the sampling weights provided by PIAAC, and rescale them so that each country has the same weight. The regressions in columns 1 and 2 are conducted for the sample of PIAAC respondents from Latin America that are ages 22 and above, have a tertiary degree, are teachers (column 1) or not teachers (column 2), are wage earners, are currently employed, work 20 or more hours a week, and are not in the bottom or top 1 percent of their country's wage distribution. Both regressions exclude university professors and other teachers at tertiary-level institutions. The regressions in columns 3 and 4 are conducted for the analogous samples in the OECD countries with average math and reading PISA scores above the OECD mean in 2015. * significant at 10%; ** significant at 5%; *** significant at 1%.

6 CONCLUSIONS

In this paper, we document a novel and worrisome stylized fact: a large share of Latin American teachers have low levels of cognitive skills. Around half of the teachers evaluated in the region score at proficiency level 1 or below in the numeracy and literacy domains of the PIAAC survey. This implies, for example, that they have difficulty in understanding basic statistics and comparing two pieces of information from a text. These low levels of cognitive skills are the result of both relatively low levels of competencies among the population of these countries and—in the case of numeracy skills—a teacher skills gap, that is, teachers have lower skills on average than the rest of the tertiary-educated population. Furthermore, in line with previous studies, we observe that individuals who graduate with teaching degrees tend to have lower levels of skills than individuals who graduate with other tertiary degrees, a gap that is larger than the teacher skills gap. We show that most of this difference is explained by the selection of individuals with non-teaching degrees into teaching.

Low levels of cognitive skills could hinder the capacity of many Latin American teachers to adequately perform their job. There are many dimensions that make a good teacher, and cognitive skills are only one of them. However, it seems hard to imagine that an education system can steadily improve student learning if many teachers lack basic skills. There has been a lot of attention in policy discussions about the importance of attracting individuals from the top of the skills distribution into teaching. The evidence presented here suggests an alternative pathway: limiting the entry into teaching of individuals with very low levels of skills. This argument is in line with findings in Neilson, Gallegos, and Calle (2019), who use data from Chile to show how a screening policy that limits the access to teacher colleges of students with low levels of achievement in the entrance exam can significantly improve the pool of future teachers in several performance dimensions. The evidence presented here also shows that screening on the basis of having a tertiary degree is not enough, as we find that many teachers with tertiary education have low levels of numeracy and literacy skills. Improving how institutions that grant teaching degrees attract, select, and train future teachers seems imperative. Recruiting individuals with non-teaching degrees is useful to improve the pool of teachers in terms of cognitive skills, but they might need to acquire specific teaching skills to be effective teachers. Improving hiring and induction processes or teacher certification programs to guarantee that all teachers have a minimum set of skills seems a promising avenue for policy. Finally, policies directed at making teacher wages less dependent on seniority and more on performance and skills are worth exploring.

ADDITIONAL FILE

The additional file for this article can be found as follows:

- **Online Appendix Figures and Tables.** Tables A.1–13 and Figures A.1–7. DOI: https://doi.org/10.31389/eco.412.s1

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COMPETING INTERESTS

The authors have no competing interests to declare.

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