Working Paper 136

Young Lives
An International Study of Childhood Poverty

Bilingual Education in Latin America:

Does Quechua-Medium Education Improve Peruvian Indigenous Children's Academic Achievement?

Disa Hynsjö and Amy Damon

www.younglives.org.uk

JANUARY 2015

Working Paper 136

Young Lives
An International Study of Childhood Poverty

Bilingual Education in Latin America:

Does Quechua-Medium Education Improve Peruvian Indigenous Children's Academic Achievement?

Disa Hynsjö and Amy Damon

www.younglives.org.uk **JANUARY 2015**

Bilingual Education in Latin America:
Does Quechua-Medium Education Improve Peruvian Indigenous Children's Academic Achievement?

Disa Hynsjö and Amy Damon

ISBN: 978-1-909403-50-5

A catalogue record for this publication is available from the British Library.

Printed on FSC-certified paper from traceable and sustainable sources.

Funded by

UKaid from the British people

Ministry of Foreign Affairs of the Netherlands

Irish Aid
An Roinn Gnóthaí Eachtracha agus Trádála
Department of Foreign Affairs and Trade

Young Lives, Oxford Department of International Development (ODID), University of Oxford, Queen Elizabeth House, 3 Mansfield Road, Oxford OX1 3TB, UK

Tel: +44 (0)1865 281751 • E-mail: younglives@younglives.org.uk

Contents

	Abstract	**ii**
	The Authors	**ii**
	Acknowledgements	**ii**
1.	**Introduction**	**1**
2.	**Context: indigenous people and bilingual education in Peru**	**3**
3.	**Theoretical framework**	**5**
4.	**Data**	**6**
	4.1. Outcome variables	7
	4.2. Control variables	11
5.	**Empirical strategy**	**13**
	5.1. Estimation issues	14
6.	**Results**	**17**
7.	**Alternative specifications**	**21**
8.	**Conclusion**	**29**
	References	**30**
	Reviewer appendix	**34**

Abstract

This study uses Peruvian school-level data from the Young Lives international study of childhood poverty to investigate the effect of Quechua-medium instruction on academic achievement. We estimate an education production function and find that indigenous children who attend Quechua-medium schools achieve mathematics scores 0.54 standard deviations higher than indigenous children who attend Spanish-medium schools. We find weak and inconclusive evidence that indigenous children who attend Quechua-medium schools attain higher language test scores. There is no evidence that these effects are caused by quantitative or language achievement prior to entering school. Our findings suggest that indigenous-language-medium education for Latin American indigenous children may play a role in ameliorating the indigenous test score gap.

The Authors

Amy Damon is an Associate Professor in the Department of Economics at Macalester College. She earned her PhD in Applied Economics at the University of Minnesota and holds an MS in Agricultural Economics from Michigan State University. Her research interests include education, nutrition, and agricultural production in Latin America and East Africa.

Disa Hynsjö is a research assistant at the Industrial Relations Section at Princeton University. Her main research interests are within development and gender economics. She holds a BA in Economics and Mathematics from Macalester College.

Acknowledgements

We thank Santiago Cueto, Paul Glewwe, Aine McCarthy, Karine Moe, Raymond Robertson and Sarah West for comments, and the Young Lives survey team for allowing us access to the data. Any errors are solely the responsibility of the authors.

About Young Lives

Young Lives is an international study of childhood poverty, following the lives of 12,000 children in 4 countries (Ethiopia, India, Peru and Vietnam) over 15 years. **www.younglives.org.uk**

Young Lives is funded from 2001 to 2017 by UK aid from the Department for International Development (DFID), co-funded by the Netherlands Ministry of Foreign Affairs from 2010 to 2014, and by Irish Aid from 2014 to 2015.

1. Introduction

In much of Latin America, indigenous children have lower levels of educational attainment and achievement than their non-indigenous peers. A large body of economic literature substantiates the importance of educational achievement for economic welfare over an individual's lifetime, as well as for economic growth (for example, Currie and Thomas 1999; Fertig 2003; Glewwe 2002; Hanushek and Woessmann 2012; Cawley et al. 2001). The persistent achievement gap between indigenous and non-indigenous children thus has long-term effects on the economic welfare of indigenous people and communities and has the potential to reinforce social inequities. Indigenous children in Latin America have traditionally only had access to education mediated through the dominant language, usually Spanish (Enrique López 2014). In recent decades, however, several Latin American governments have implemented bilingual or indigenous-language-medium education programmes targeting the indigenous population (Cortina 2014). Few studies investigate the effects of such programmes in Latin America, and very scant quantitative evidence exists about the effect of the language of instruction on schooling outcomes in developing countries in general. To fill this gap, we use the unusually detailed school-level data from the Young Lives international study of childhood poverty and investigate whether attending a Quechua-medium school affects Peruvian indigenous children's achievement in mathematics and language.

Researchers use the education production function framework to measure the effects of specific variables on educational outcomes in the USA (for example, Card and Krueger 1992) and in developing countries (for example, Case and Deaton 1999 and Glewwe 2002). This research clearly shows that groups with limited access to resources, who also often speak minority languages, achieve lower scores in academic and cognitive tests, as compared to more privileged groups.[1] This achievement gap has been shown to increase over the school years in the USA, Canada and Australia (Fryer and Levitt 2004, 2006; Hanushek and Rivkin 2009; Friesen and Krauth 2010; Bradley et al. 2007; Leigh and Gong 2009). Similar research from developing countries is scarce, though recent evidence from Peru suggests that children from ethnic minorities learn less in school than children from the ethnic majority, even when attending the same school (Glewwe et al. 2014). It is thus possible that educational systems in both developed and developing countries do not adequately meet the needs of indigenous and minority children. In the cases where those children are also from linguistic minorities, the language of instruction may play a role in their learning.

A large body of research examines the effect of bilingual and immersion programmes on educational outcomes for English language learners in the USA. However, there is little consensus about the learning outcomes of such programmes and this literature is plagued with methodological concerns (see, for example, Groff 2005; Slavin and Cheung 2005).[2] Slavin and Cheung (2005) provide a meta-analysis of 17 high-quality studies of bilingual

1 Researchers find achievement gaps between black and white children in the United States (Fryer and Levitt 2004, 2006; Hanushek and Rivkin 2009; Clotfelter et al. 2009) and the UK (Patacchini and Zenou 2009); Indian Americans and whites in the USA (Fischer and Stoddard 2013); Roma and non-Roma in Hungary (Kertesi and Kézdi 2011); indigenous and non-indigenous children in Australia (Bradley et al. 2007; Leigh and Gong 2009), Chile (McEwan 2004), Peru (Sakellariou 2008) and Guatemala (McEwan and Trowbridge 2007); and lower and higher castes in India (Borooah 2012).

2 These concerns include the appropriate timing of assessing children who are students of transitional bilingual programmes, and selection and attrition bias.

reading programmes in the USA. They find that evidence generally favours bilingual instruction and that the median-weighted effect was +0.33 standard deviations on reading test scores for bilingual education. Slavin and Cheung suggest that teaching students to read in their native language can help them improve letter and word recognition, which can then be translated into improved reading skills in English.

Several studies in the education field investigating developing countries find that children in indigenous-language-medium classrooms engage more with their teachers and have higher test scores compared to children not taught in their mother tongue (Benson 2010; Hovens 2002; Truong 2012; Trudell 2005; Walter and Dekker 2011; Benson 2000; Enge and Chesterfield 1996; Lavoie 2008). Some of these papers discuss selection issues, but none to our knowledge apply any estimation techniques to account for this or other possible confounding factors. Walter and Dekker (2011) provide the most rigorous examination of this question, employing an experimental methodology. However, the study only focuses on differences in mean scores between treatment and control groups. Walter and Dekker do not carry out any regression analysis that controls for possible confounding factors. Their data lack any individual-level information to convince the reader that students in the control and treatment groups were comparable before the experiment. Given these serious limitations, we attempt to provide more robust evidence by applying econometric estimation techniques to isolate the effect of the language of instruction on achievement.

In the economics literature, Marshall (2009) finds suggestive evidence that Mayan-language instruction increases mathematics scores in Guatemala, but his study does not report the size of that effect nor investigate its robustness. Being instructed in a Mayan language and having access to bilingual education are associated with a higher probability of school enrolment in Guatemala and Mexico, respectively (Marshall 2011; Parker et al. 2005), while no such effect was found in Peru (Rodriguez Lozano 2012). McEwan (2008) argues that the gap in test scores between indigenous and non-indigenous children, hereafter referred to as 'the indigenous test score gap', decreased in Chile because more resources were shifted to indigenous children within schools, although this research does not address the medium of instruction specifically. Cueto and Secada (2003) examined the effects of bilingual education in Peru in 2000 but found that attending a bilingual school had no effect. This study used an analysis of student notebooks, household surveys and a test administered during the study. While this study is an important input into our understanding of the Peruvian bilingual education landscape, the results are tenuous given the possible selection not accounted for as well as the possibility for bias in the evaluation instruments.

This paper fills a gap in the literature by estimating the effect of indigenous-language-medium instruction on academic achievement in Peru and is the first rigorous estimate of its kind to our knowledge in Latin America. We find that indigenous children (defined as indigenous if the mother speaks Quechua as her native language) who attend Quechua-medium schools obtain mathematics scores 0.54 standard deviations higher than indigenous children who attend Spanish-medium schools. The evidence for a positive effect on language achievement is weak and only significant when defining 'indigenous' narrowly as having two parents who speak Quechua.

In interpreting our results, it is important to consider the limitations imposed by our relatively small sample size, cross-sectional data and non-random assignment to Quechua-medium schools. Our sample includes a total of 1,343 children, of whom 284 are indigenous and 72 attend Quechua-medium schools. The indigenous children in our estimation attend eight different Quechua-medium schools and 58 different Spanish-medium schools. In addition to our primary analysis, we also estimate a value-added model for a sub-set of the observations for which we have access to longitudinal data. This analysis replicates the main results but includes only 514 children, of whom 152 are indigenous and only 40 attend Quechua-medium schools. We also implement an instrumental variable (IV) estimation, using the proportion of indigenous children in the school as an instrument for Quechua-medium education, which also supports the main results. The validity of our instrument is challenged by the strong correlation between indigenous status and poverty as well as by previous literature that argues for an indigenous 'peer effect' that is independent of observable controls. Considering these issues, our results cannot be considered conclusive and a large-scale controlled experiment would be ideal to assess their validity.

This paper proceeds as follows. The next section outlines the Peruvian context, in terms of indigenous people and bilingual education. Section 3 presents the theoretical framework. Section 4 presents the data, and Section 5 the empirical strategy, including estimation issues. The results and robustness sections follow. Section 8 concludes.

2. Context: indigenous people and bilingual education in Peru

Most often, a person is considered 'indigenous' in Peruvian censuses and in academic literature concerning Latin America if he or she speaks an indigenous language (Kudó 2004; McEwan 2008, 2004; Parker et al. 2005). By this definition, four million Peruvians, or about 16 per cent of the nation's population (Census Naciónal 2007), are indigenous, and speak at least one of the country's 43 indigenous languages (DIGEIBIR 2013). The largest group of Peru's indigenous population, 3.4 million people, speaks Quechua, while almost half a million speak Aymara, and about 240,000 speak a wide range of other indigenous languages (Census Naciónal 2007). This population fares worse both economically and socially than the majority population (Cortina 2014). In Peru, about 80 per cent of the indigenous population is poor, and almost half extremely poor. Indigenous Peruvians have higher rates of child malnutrition and infant mortality, and tend to live in more isolated communities with poorer access to services (Kudó 2004). Indigenous children are more likely to work, repeat grades in school or leave school prematurely (Rodriguez Lozano 2012; Kudó 2004).

Peruvian indigenous children's low educational achievement is therefore no surprise. These results are exacerbated by the fact that the country as a whole lags behind in international comparisons of academic achievement and has among the highest internal inequalities of performance in the world.[3]

Native-language-medium education is provided through the Educación Intercultural Bilingüe (EIB) programme. The official purpose of this programme is to increase indigenous children's educational opportunities and to recognise Peru as a multilingual and multicultural society. Government documents present the EIB as a departure from the tradition of homogenisation and forced hispanisation of indigenous communities (DIGEIBIR 2013).

3 Peru performed worst of all participating countries in the Programme for International Student Assessment (PISA) in 2000, and had the second-highest internal inequality of performance in both PISA 2000 and the Trends in International Mathematics and Science Study (TIMSS) 1999 and 2003 (Crouch 2007).

Bilingual education was instituted in Peru during the 1970s but has grown significantly over the past 20 years (DIGEIBIR 2013; Rodriguez Lozano 2012). Over 1,200 schools implement the EIB programme (Rodriguez Lozano 2012). Estimates of the availability of the EIB programme to indigenous children vary from 37 per cent (Cordova 2012) to 50 per cent of these children (Kudó 2004). The EIB programme does not constitute an alternative to the national curriculum; all Peruvian children are expected to study the same subjects. Rather, the curriculum has been modified to include culturally sensitive and indigenous-language materials to be used in regions with indigenous populations (Garcia 2010, DIGEIBIR 2005).

Studies in educational psychology examine a wide variety of methods for second language acquisition and scrutinise the effectiveness of these programmes for minority language speakers. Padilla (2006) classifies different types of programmes that integrate minority language speakers into the majority language education system according to whether the medium of instruction is the minority or majority language, as well as other factors. In the context of Padilla's classifications, the EIB programme is closest to a bilingual instructional programme (Cueto and Secada 2003). Peru's EIB programme emphasises that classes should be taught in indigenous languages in the lower grades of primary school, but all children are expected to eventually be sufficiently proficient in Spanish to study in Spanish. The programme specifies that the rate at which instruction shifts from the native language to Spanish should depend on the child's initial proficiency in Spanish. For example, according to the programme, indigenous children who enter school as monolingual in an indigenous language should learn all subjects in their mother tongue in Grades 1 and 2, including Spanish as a second language. In Grade 3, Spanish-medium instruction should make up 20 per cent of class time, and this share should increase by 10 percentage points each year, to reach 50 per cent by Grade 6 (DIGEIBIR 2013).

Peru's EIB programme has not been studied extensively, but both earlier and more recent studies have found obstacles to its implementation: some schools lacked bilingual educational materials (Garcia 2010; Montoya Rojas 2001; DIGEIBIR 2005); the guidelines on medium of instruction were difficult to follow in multi-grade schools (Rodriguez Lozano 2012); teachers with adequate language knowledge were not always available (Montoya Rojas 2001; Kudó 2004); teacher-training sessions were insufficient (Garcia 2010; Montoya Rojas 2001; Trapnell 2003) and the 'intercultural' aspect of the programme was difficult to implement (Kudó 2004, DIGEIBIR 2005). In addition, although the Government emphasises the importance of collaborating with communities (DIGEIBIR 2013, 2005), many indigenous parents rejected bilingual education since they feared that it might interfere with Spanish acquisition (Garcia 2010; Montoya Rojas 2001; Kudó 2004).

López (2002) used fieldwork data collected between 1999 and 2001 from 14 indigenous or bilingual communities to analyse language practice in EIB classrooms. In many cases when children predominantly spoke an indigenous language, teachers presented class materials in the appropriate native language. In several of the 14 communities, indigenous-language instruction dominated in the first couple of grades, while older children were taught in Spanish. It was also common that the teacher taught classes in Spanish, but used Quechua in order to explain words or concepts that the children did not understand (López 2002). Rosales (2012) found that in the Young Lives school-level data, when most children were in Grade 4 or higher, most instruction was in Spanish, and teachers indicated that they mostly used Quechua to facilitate learning in Spanish. It thus appears that we should expect the children in this study to have had more exposure to Quechua-medium instruction in earlier grades than necessarily the grade they are currently in (mostly Grades 4 and 5).

In this study we focus on Quechua-speaking indigenous children for reasons explained below. However, it should be noted that there is significant heterogeneity in the implementation of the EIB programme at the school level. Given this heterogeneity we narrow our definition of Quechua-medium schools to only include EIB schools in which the teachers have received specific training in bilingual teaching. Teacher training is one factor that increases the likelihood that the programme is being implemented closer to its original intention. While this definition admittedly does not account for all of the heterogeneity in the way the programme is implemented, it at least narrows the range of implementation strategies used within our sample.

3. Theoretical framework

This section provides a theoretical discussion to frame our empirical strategy. It closely follows the thorough presentation of theoretical issues in Glewwe (2002) and adapts his approach, in order to highlight the language of instruction as a component of school quality. Following Glewwe (2002) we assume that there are two time periods. In the first one a child can work or go to school, while in the second time period, which represents the child after school, the child (who now may be an adult) works. In this model parents make choices to maximise their household's utility, which is a function of consumption in both periods, and a child's cognitive skills, A. Parents maximise their household's utility subject to a cognitive production function, and a budget constraint. The cognitive production function is defined as:

$$A = \alpha f(Q) g(S) \qquad (1)$$

where Q is school quality, S is years of schooling and f and g are individual functions increasing in Q and S and α is a measure of a child's innate learning efficiency. A child's performance in the labour market is dependent on their cognitive ability A. Parents maximise utility by choosing both Q^* and S^*, both defined in Glewwe (2002). Parents will choose higher levels of both Q and S when they put more weight on their child's cognitive ability.

As Glewwe (2002) points out, school quality as measured by a single variable is highly oversimplified, and in reality school quality is better measured by an index of observable characteristics, $\{Q_1, Q_2, \ldots Q_n\}$. In our case we are interested in a specific observed component of school quality, namely whether the language of instruction is the native language of the child, $Q_{Native\ Medium}$. As discussed, there is inconclusive evidence on how the language of instruction affects the efficiency with which a child's learns. We hypothesise that children taught in their native language acquire a deeper understanding of academic materials, leading to better academic outcomes and as such increases in the measured level of A. We therefore expect a positive relationship between indigenous-language instruction and cognitive ability. Padilla (2006) substantiates this hypothesis by stating that well-designed bilingual programmes result in students who attain higher achievement scores in both reading and mathematics tests than minority language students who are placed in majority language schools with no language transition programme – the so-called 'sink-or-swim' approach.

The magnitude of this positive relationship may differ according to how achievement is measured. We use scores obtained in mathematics and language tests in order to measure academic achievement. These tests were administered in Spanish. This means that many indigenous children in our sample took the tests in their second language, which may imply that they were unable to perform to the best of their ability.

Presumably, the negative effect of taking a test in a language other than one's native language is greater if the test assesses language than if it assesses mathematics. It is therefore possible that the language scores relate more closely to indigenous students' knowledge of Spanish as a second language than to their communication abilities. In this scenario, the merit of receiving instruction in one's native language is unclear since such education would focus on enhancing communication abilities primarily in the first language. As a result, we expect this research to show a stronger effect of Quechua-medium instruction on mathematics achievement than on language achievement.

The theoretical framework states that academic achievement depends on parents' tastes and their inputs into the cognitive production function. The test score literature from both developed and developing countries establishes that household-level variables such as wealth, parents' education, gender, siblings and indigenous status are important determinants of academic achievement, indicating that these variables are important controls to consider in our empirical analysis (McEwan and Trowbridge 2007; McEwan 2004, 2008; Marshall 2009; Sakellariou 2008). Theoretically, schools with more resources and better-educated, more experienced teachers and headteachers would be expected to affect academic achievement positively. However, the effect of schools' quality in general has not been firmly established (for a summary, see Glewwe et al. 2011).

4. Data

The Young Lives international study of childhood poverty administered three rounds of household-level surveys in 2002, 2006 and 2009. School-level surveys were also administered; in Peru this took place in October and November of 2011. In each of the four countries in the study, Young Lives follows one Younger Cohort born in 2001–2, and one Older Cohort born in 1994–5, of about 2,000 and 1,000 children, respectively. The Peruvian school-level survey is composed of a sub-set of 654 Younger Cohort children included in the household-level rounds, as well as 1,207 of those children's peers, who were only sampled in the school-level survey. These 1,861 children attended 132 different schools in nine regions of Peru (Guerrero et al. 2012). Demographic information is not available for all children included in the school survey, but of those with such information available, 30 per cent are indigenous.

The data include contemporary information for all sampled children, and detailed historic information only for the sub-sample of children previously surveyed during the household rounds. Due to the relatively small overlap between the school survey sample and household survey sample we use the data collected during the school round in our baseline specifications.[4] As part of the school survey, Young Lives administered student, headteacher and teacher questionnaires, which covered a wide range of information including the schools' resources, institutional management, school and classroom environment, and students and teachers' attitudes, as well as academic achievement tests (Guerrero et al. 2012).

In order to create the school survey sample, Young Lives first selected a sub-sample of the Younger Cohort included in the household-level survey, and then randomly selected up to 20 peers in each school attended by the selected Younger Cohort children. In defining the Younger Cohort sub-sample to be included in the school-level sample, Young Lives used a

4 We use the household-level data in several robustness checks.

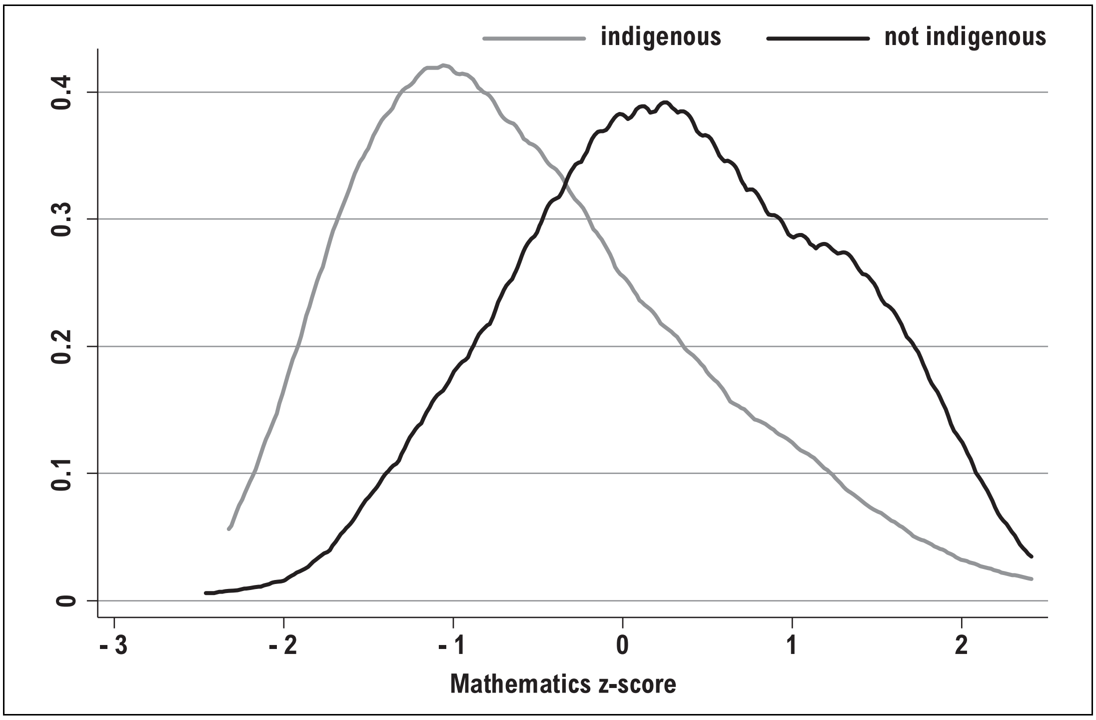
random sampling approach, but included all children who attended EIB schools (Guerrero et al. 2012).[5] The Younger Cohort children included in the school-level sample are spread out across Grades 2, 3, 4, 5 and 6 of primary school, with most students in Grade 4 and only a few students in Grades 2 and 6. In sampling Young Lives children's peers, only children from Grade 4 were included. Our baseline analysis includes all children in all grades in the school sample to increase our sample size; however subsequent analysis limits the sample to only children in Grade 4, and our results are consistent.

To construct the Peruvian Younger Cohort household survey sample, Young Lives used a pro-poor sampling approach that purposely excluded the richest 5 per cent of the population. Due to logistical feasibility and budget constraints, some areas with worse access to public services were also excluded (Escobal and Flores 2008). These sampling approaches imply that the Young Lives school-level data are not nationally representative of all Peruvian children, but they do provide adequate information to investigate the effects of specific policies. Further, given the lower socioeconomic status of most indigenous households, it is unlikely that this sampling approach would induce significant bias in our results.

4.1. Outcome variables

The outcome variables used in this study are students' scores in mathematics and language tests administered during the school survey. Both tests were administered in Spanish to all students (Guerrero et al. 2012). To simplify interpretation, we transform the test scores to z-scores with mean zero and standard deviation one.

Figure 1. *Mathematics z-scores of indigenous and non-indigenous children in Grade 4*



5 In the cases where several Younger Cohort children attended a school selected for sampling, Young Lives included all those children in the survey, even if not all of them had initially been selected to be part of the school survey sample.

The mathematics test focused on numbers and number sense, with items from national standardised tests, national evaluations and previous Young Lives achievement tests.[6] The children had 60 minutes to do the test (Guerrero et al. 2012). For each item, the school survey reports whether a student's answer is correct, incorrect or blank. For the purpose of this research, we record a blank answer as an incorrect answer. Children in different grades were administered different tests, with each test containing between 29 and 37 items. Students' scores were calculated by adding up the correct answers, such that the maximum score for the mathematics test was between 29 and 37, depending on the grade the child attended. Figure 1 shows the distribution of mathematics z-scores for indigenous and non-indigenous children in Grade 4. For the purpose of comparing the raw mean scores of indigenous and non-indigenous children in Figure 1, we only include children in Grade 4 since the mean achievement of different grades differs significantly (though all children are included in the estimations).[7] Indigenous children's achievement is clearly left-skewed, with a majority of children performing below the sample average. Non-indigenous children's achievement is more evenly distributed across the mean but slightly right-skewed. Table 1 shows that the mean difference between the mathematics scores obtained by indigenous and non-indigenous children in Grade 4 is 0.887 standard deviations, and significant at the 1 per cent level using a two-tailed t-test. This is larger than the mathematics test score gap of 0.60 standard deviations that Sakellariou (2008) reports using Peruvian data collected in 1997. Table 2 shows that indigenous children in Quechua-medium schools score about 0.14 standard deviations worse on the mathematics test, compared to indigenous children in Spanish-medium schools, but this difference is not significant.

6 All achievement tests can be found at http://www.younglives.org.uk/what-we-do/school-survey/peru-school-survey/questionnaires

7 Eighty-five per cent of the children in the final sample were in Grade 4 at the time of the survey. The mathematics test score gap is 0.674 and significant at the 1 per cent level in the sample of only children in Grade 5, while in the other grades there are too few children for the difference to be significant.

Table 1. *Summary statistics*

Variable	All children N = 1,343		Not indigenous N = 1,059		Indigenous N = 284		Difference
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	
Maths z-score	0.000	1.000	0.176	0.941	-0.657	0.940	0.833***
Language z-score	0.000	1.000	0.194	0.894	-0.722	1.044	0.915***
Quechua-medium school	0.054	0.225	0.000	0.000	0.254	0.436	-0.254***
Female	0.512	0.500	0.503	0.500	0.542	0.499	-0.039
Age	9.570	0.845	9.478	0.712	9.912	1.160	-0.434***
Preschool	0.811	0.392	0.868	0.339	0.599	0.491	0.269***
Repeated grade	0.174	0.379	0.128	0.335	0.345	0.476	-0.217***
No siblings	0.124	0.330	0.132	0.339	0.095	0.294	0.037*
Grade 2	0.003	0.055	0.000	0.000	0.014	0.118	-0.014***
Grade 3	0.031	0.172	0.020	0.139	0.070	0.256	-0.051***
Grade 4	0.842	0.365	0.851	0.356	0.810	0.393	0.041*
Grade 5	0.121	0.326	0.126	0.332	0.102	0.303	0.024
Grade 6	0.004	0.061	0.004	0.061	0.004	0.059	0.000
Mother no education	0.079	0.270	0.029	0.169	0.264	0.442	-0.235***
Mother 1–5 yrs edu	0.256	0.437	0.215	0.411	0.409	0.492	-0.192***
Mother 6–11 yrs edu	0.494	0.500	0.547	0.498	0.296	0.457	0.251***
Mother post-secondary edu	0.171	0.377	0.209	0.407	0.032	0.175	0.177***
Father no education	0.031	0.174	0.016	0.126	0.088	0.284	-0.072***
Father 1–5 yrs edu	0.219	0.414	0.170	0.376	0.401	0.491	-0.231***
Father 6–11 yrs edu	0.552	0.497	0.582	0.494	0.444	0.498	0.138***
Father post-secondary edu	0.197	0.398	0.232	0.422	0.067	0.250	0.165***
Headteacher post-secondary edu	0.397	0.489	0.437	0.496	0.247	0.432	0.191***
Maths teacher yrs experience	11.593	7.966	12.188	8.139	9.377	6.858	2.811***
Language teacher yrs experience	11.570	7.918	11.928	8.043	10.236	7.291	1.692***
Maths teacher female	0.642	0.480	0.631	0.483	0.683	0.466	-0.052
Language teacher female	0.657	0.475	0.636	0.482	0.736	0.442	-0.100***
Student–teacher ratio	22.230	6.842	22.981	6.982	19.433	5.461	3.548***
Rooms in school	16.818	10.780	18.538	10.569	10.401	9.004	8.137***
Private	0.096	0.295	0.117	0.322	0.018	0.132	0.099***
Full grade school	0.855	0.352	0.927	0.260	0.585	0.494	0.343***
Rural	0.220	0.415	0.121	0.326	0.592	0.492	-0.471***
Cement floor	0.872	0.334	0.857	0.350	0.926	0.262	-0.069***
Tile floor	0.103	0.304	0.128	0.335	0.007	0.084	0.121***
Cement roof	0.462	0.499	0.545	0.498	0.151	0.359	0.393***
Wood roof	0.457	0.498	0.388	0.488	0.715	0.452	-0.327***
Cane roof	0.014	0.118	0.018	0.133	0.000	0.000	0.018**
Tile roof	0.067	0.250	0.049	0.216	0.134	0.341	-0.085***
Brick wall	0.864	0.342	0.963	0.188	0.497	0.501	0.467***
Water outlet	0.018	0.133	0.011	0.106	0.042	0.202	-0.031***
Water well	0.125	0.331	0.053	0.224	0.394	0.490	-0.342***
Water tap	0.857	0.350	0.936	0.245	0.563	0.497	0.372***
Electricity	0.984	0.127	0.983	0.129	0.986	0.118	-0.003
Phone	0.653	0.476	0.752	0.432	0.285	0.452	0.466***
Internet	0.630	0.483	0.704	0.457	0.356	0.480	0.348***
Toilet	0.774	0.419	0.874	0.333	0.401	0.491	0.472***
Library	0.545	0.498	0.586	0.493	0.394	0.490	0.191***
Dictionary	0.830	0.376	0.863	0.344	0.708	0.456	0.155***
Books	0.768	0.422	0.771	0.421	0.761	0.427	0.010
Computers	0.762	0.426	0.799	0.401	0.627	0.485	0.172***
XO laptops[a]	0.707	0.455	0.689	0.463	0.775	0.419	-0.085***
Calculator	0.443	0.497	0.452	0.498	0.409	0.492	0.044
Average wealth 2009	0.595	0.168	0.642	0.136	0.421	0.165	0.220***
Average housing quality 2009	0.474	0.197	0.518	0.183	0.309	0.156	0.209***
Average wealth 2006	0.519	0.192	0.568	0.165	0.336	0.175	0.232***
Average housing quality 2006	0.430	0.183	0.465	0.178	0.296	0.138	0.169***

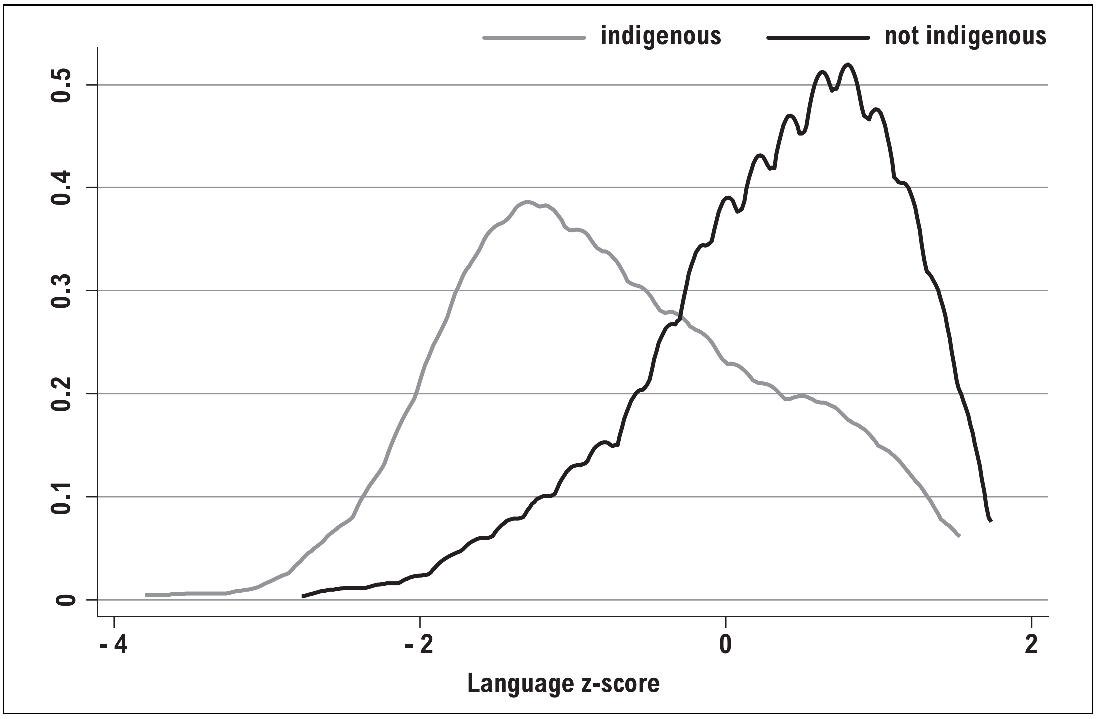
Notes: Mean differences significant at the 10, 5 and 1 per cent levels are indicated by *, ** and ***, respectively.
To calculate the difference in z-scores, only children in Grade 4 were included.
[a] XO laptops are low-cost laptops distributed to part of the poor population in Peru.

Table 2. *Indigenous children: child- and household-level summary statistics*

Variable	Indigenous child in Spanish-medium school N = 212		Indigenous child in Quechua-medium school N = 72		Difference
	Mean	St. dev.	Mean	St. dev.	
Maths z-score	-0.640	0.926	-0.705	0.987	0.064
Language z-score	-0.649	1.046	-0.937	1.017	0.289**
Quechua-medium school	0.000	0.000	1.000	0.000	-1.000
Female	0.571	0.496	0.458	0.502	0.112*
Age	9.759	1.112	10.361	1.190	-0.602***
Preschool	0.665	0.473	0.403	0.494	0.262***
Repeated grade	0.293	0.456	0.500	0.504	-0.208***
No siblings	0.090	0.286	0.111	0.316	-0.022
Mother no education	0.170	0.376	0.542	0.502	-0.372***
Mother 1–5 yrs edu	0.448	0.498	0.292	0.458	0.157**
Mother 6–11 yrs edu	0.340	0.475	0.167	0.375	0.173***
Mother post-secondary edu	0.043	0.202	0.000	0.000	0.043*
Father no education	0.066	0.249	0.153	0.362	-0.087**
Father 1–5 yrs edu	0.349	0.478	0.556	0.500	-0.207***
Father 6–11 yrs edu	0.505	0.501	0.264	0.444	0.241***
Father post-secondary edu	0.080	0.272	0.028	0.165	0.052

Note: Mean differences significant at the 10, 5 and 1 per cent levels are indicated by *, ** and ***, respectively.

Figure 2. *Language z-scores of indigenous and non-indigenous children in Grade 4*



The language tests focused on written communication, with 26 to 30 items from national standardised tests and national evaluations. Again, the children had 60 minutes to do the test (Guerrero et al. 2012). The school survey reports whether each student's answer is correct, incorrect or blank, and we record a blank answer as an incorrect answer. Figure 2 shows the distribution of language z-scores for indigenous and non-indigenous children in Grade 4.[8] As with the mathematics scores, indigenous children's language scores are clearly left-skewed, with most children performing below the sample mean. Non-indigenous children's achievement is clearly right-skewed, with most children performing above the sample average. Table 1 shows that the mean difference between the language z-scores obtained by indigenous and non-indigenous children in Grade 4 is 1.030 standard deviations, and that the difference is significant at the 1 per cent level. Like the mathematics scores, this is larger than the difference of 0.83 standard deviations that Sakellariou (2008) reports for language scores. Table 2 shows that indigenous children in Quechua-medium schools score about 0.3 standard deviations worse on the language test than indigenous children in Spanish-medium schools, and that the difference is significant at the 5 per cent level.

4.2. Control variables

Table 1 summarises the data used in the analysis, and compares the mean for indigenous and non-indigenous students. Young Lives collected information about the children's parents' education and language by consulting school records (Guerrero et al. 2012). This information was often missing and this is the main reason why the final sample size is considerably smaller than the initial sample size. The final sample includes 1,343 children, where 21 per cent, or 284 children are indigenous.

Table 1 confirms the a priori expectation that indigenous children on average have lower socioeconomic status than their non-indigenous peers, and attend schools with fewer resources and worse infrastructure compared to them. Indigenous children are less likely to have attended preschool and more likely to have repeated grades. Fewer indigenous children have no siblings and their parents have lower levels of education. Indigenous students attend schools with less educated headteachers and whose teachers have fewer years of experience. Their schools are smaller, more likely to be rural, and less likely to be private or full grade schools. Indigenous children are significantly less likely to attend a school with access to tap water, a phone, the internet, toilets, a library, dictionaries or encyclopedias, books or computers. Differences in indigenous children's schools' physical infrastructure and school-level wealth exhibit similar patterns.

In order to better understand the circumstances of the indigenous children who attend Quechua-medium schools and whether these are different from those of indigenous children who attend Spanish-medium schools, we examine the data for the indigenous children only. Table 2 summarises the child- and household-level data for the indigenous children, and Table 3 summarises the school-level data for the schools that at least one indigenous child attends.

8 The language test score gap is 0.651 and significant at the 1 per cent level in the sample of only children in Grade 5, while in the other grades there are not enough children to make the difference significant.

Table 3. *Schools attended by indigenous children*

Variable	Spanish-medium N = 58	Quechua-medium N = 8	Difference
Headteacher post-secondary edu	0.293	0.000	0.2931*
Maths teacher yrs experience	10.707	9.750	0.957
Language teacher yrs experience	10.759	11.750	-0.991
Maths teacher female	0.759	0.625	0.134
Language teacher female	0.793	0.750	0.043
Student–teacher ratio	22.091	17.544	4.547*
Rooms in school	13.776	4.875	8.901**
Private	0.017	0.000	0.017
Full grade school	0.707	0.250	0.457**
Rural	0.431	1.000	-0.569***
Cement floor	0.897	1.000	-0.103
Tile floor	0.017	0.000	0.017
Cement roof	0.362	0.000	0.362**
Wood roof	0.535	1.000	-0.466**
Cane roof	0.017	0.000	0.017
Tile roof	0.086	0.000	0.086
Brick wall	0.707	0.125	0.582***
Water outlet	0.035	0.000	0.035
Water well	0.224	0.500	-0.276*
Water tap	0.741	0.500	0.241
Electricity	0.948	1.000	-0.052
Phone	0.448	0.000	0.448**
Internet	0.414	0.250	0.164
Toilet	0.603	0.125	0.478**
Library	0.500	0.125	0.375**
Dictionary	0.793	0.625	0.168
Books	0.793	0.625	0.168
Computers	0.655	0.625	0.030
Calculator	0.414	0.500	-0.086
Average wealth 2009	0.394	0.246	0.148*
Average housing quality 2009	0.314	0.230	0.084
Average wealth 2006	0.472	0.357	0.115
Average housing quality 2006	0.347	0.232	0.116

As Table 2 shows, in the final sample, 212 indigenous children attend Spanish-medium schools, and 72 attend Quechua-medium schools. The indigenous children in Quechua-medium schools do not score significantly lower on the mathematics achievement test, but score 0.289 standard deviations worse on the language achievement test, compared to their counterparts in Spanish-medium schools. Indigenous children in Quechua-medium schools in general seem to be socially and economically worse off than their counterparts in Spanish-medium schools. Indigenous children in Quechua-medium schools are less likely to have attended preschool, more likely to have repeated grades, and have parents with fewer years of education in general. Table 3 exhibits a similar pattern at the school level. In the final sample there are eight Quechua-medium schools and 58 Spanish-medium schools that at least one indigenous child attends. None of the Quechua-medium schools' headteachers have post-secondary education. Compared to the Spanish-medium schools, the Quechua-medium schools are smaller and are less likely to be full grade schools. All the Quechua-medium schools are rural and have worse physical infrastructure in general. None of the Quechua-medium schools have a phone; they are less likely to have toilets or a library; and the average household wealth among students attending Quechua-medium schools was lower in 2009.

5. Empirical strategy

In this study we use test scores to measure academic achievement. We are therefore interested in estimating the education production function as a function of household, child and school characteristics. Many studies that estimate test scores employ the cognitive production function by using either the cumulative, value-added or contemporaneous specification, as elaborated by Todd and Wolpin (2003). In this paper, we primarily focus on the contemporaneous specification, since historic variables and lagged test scores are only available for a sub-sample of the data.[9] This specification relates academic achievement to contemporaneous school and family inputs. Implicitly, contemporaneous inputs are assumed to appropriately account for historic inputs and be unrelated to innate ability. Although these assumptions are strong (Todd and Wolpin 2003), we follow other researchers (Fischer and Stoddard 2013; McEwan 2008) who use the contemporaneous specification when the contributions of historic inputs are not of primary interest.

Generally, there is assumed to be a linear relationship between the inputs into the cognitive production function and academic achievement (Todd and Wolpin 2007). The appropriate estimator is therefore ordinary least squares (OLS).[10] In the case of OLS, however, variation in children's innate ability and other selection effects are absorbed by the error term. We address these concerns below. We estimate this equation:

$$A_i = \beta_0 + \beta_1 B_i + \beta_2 X_i + \beta_3 Q_i + \beta_4 R_i + \epsilon_i \qquad (2)$$

where cognitive achievement, A, is measured by either mathematics or language test scores. These measures of cognitive ability and academic achievement are explained by the following factors: indigenous-language-medium education, B, a vector of child characteristics, X, a vector of household characteristics, Q, a vector of school characteristics, R, and a random component, ϵ.

The explanatory variable of interest is B, which is a dummy variable to indicate whether a child attends a Quechua-medium school, as defined in this paper (an EIB school whose teachers have received training in bilingual teaching). In the vector X, child characteristics, we include indigenous status, gender, grade repetition, age, whether the child lives together with any siblings, and preschool attendance. This is in line with the test score literature for Latin America (Marshall 2009; McEwan 2008; 2004; Sakellariou 2008; Meade 2012). As mentioned earlier, in accordance with previous literature, we define a child as indigenous if his or her mother speaks an indigenous language. We also include the child's current grade in school, in order to control for achievement differences that are constant across grades.

The most important components of the vector Q, household characteristics, are controls for socioeconomic status, including parents' education, income and wealth (Hanushek 1986; McEwan and Trowbridge 2007; Marshall 2009; McEwan 2008, 2004). We control for both father's and mother's education, but the data include further household information only for the sub-set of observations previously included in the Young Lives household-level rounds. We therefore control for wealth effects by including all available information on school

9 We use this sub-sample to perform robustness checks.

10 Multicollinearity between the main explanatory variable and any of the control variables is small, and we account for heteroskedasticity by reporting robust standard errors.

infrastructure and several of the school's material resources, as well as the school-level averages of wealth and housing-quality indices obtained from the sub-set of children for whom additional information is available. We expect school-level variables to capture indigenous children's higher rates of poverty, and thus the effect of wealth on academic achievement.

In the vector *R*, school and teacher characteristics*,* we include controls for student–teacher ratio, number of classrooms, whether the school is a full grade school, teacher's gender and years of experience, the headteacher's education, and whether the school is private. Recent research from Latin America suggests that such variables may influence academic achievement (Marshall 2009; McEwan and Trowbridge 2007; McEwan 2004). However, there exists no consensus as to which specific school- and teacher-level characteristics affect achievement in developing countries in general (see Glewwe et al. 2011). We therefore test the results for sensitivity to the definition of *R*.

5.1. Estimation issues

There are a number of important empirical issues to consider when estimating the relationships outlined above. The goal is to estimate β_1, the coefficient on Quechua-medium education, for indigenous children. The comparison of primary interest is the academic achievement of indigenous children in Quechua-medium schools with indigenous children in Spanish-medium schools. The ideal dataset for this purpose would be a large sample of Peru's indigenous population randomly assigned between Spanish- and Quechua-medium schools. This, of course, is not available. Only 284 of the 1,343 children in our final sample are indigenous. Of the indigenous children, 72 attend Quechua-medium schools, and 212 attend Spanish-medium schools. Ignoring selection issues, a reasonable approach would be to estimate a model using an interaction term between Quechua-medium school attendance and indigenous status. However, given that no non-indigenous children attend Quechua-medium schools it suffices to include one dummy variable for indigenous status and one for whether the child attends a Quechua-medium school. Since there are only indigenous children in the latter group, this is equivalent to reporting an interaction term between indigenous status and Quechua-medium education, apart from the fact that any constant effect of attending a Quechua-medium school is not accounted for.

Non-random programme assignment is a problematic identification issue. We approach this problem by examining several potential avenues of selection and provide argument and evidence that, considering unaccounted for selection bias, our estimates represent a lower bound.

As discussed in the Data section, indigenous children who attend Quechua-medium schools appear to be worse off, in general, than indigenous children who attend Spanish-medium schools. We would expect indigenous children in Quechua-medium schools to be worse off in terms of unobserved household-level variables as well. Since socioeconomic status is a strong determinant of academic achievement, this would imply that our estimates are likely to be lower bound.

There is little systematic research on Quechua-speaking parents' attitudes to the EIB programme. The existing qualitative evidence suggests that some Quechua-speaking parents express disapproval of the programme since they fear that it may impede children's

Spanish acquisition (Garcia 2010; López 2002),[11] while others welcome instruction in Quechua (López 2002). Thus, the qualitative evidence does not allow us to make any strong predictions of whether Quechua-speaking parents would be more likely to prioritise Spanish- or Quechua-medium education for their academically stronger children. It is clear, however, that Quechua-speaking parents do not uniformly appreciate the EIB programme. If this attitude predominates, we would expect β_1 to be biased downward.

All tests were administered in Spanish. As Slavin and Cheung (2005) point out, it is not clear in which grade it is appropriate to assess students who attend transitional bilingual schools, such as the Quechua-medium schools in Peru, in their second language. If children have not been exposed to Spanish in school they may be less able to understand testing materials than their counterparts in Spanish-medium schools, even if they are of equal ability. In addition, the EIB programme targets the indigenous population. It is likely that a greater proportion of indigenous children living in areas with access to EIB schools are monolingual compared to indigenous children living in Spanish-speaking communities, without access to EIB schools. It is likely that many children in the latter category are bilingual in Spanish and Quechua. Spanish-medium education may therefore be less of a disadvantage to some children that we identify as 'indigenous' (those who attend Spanish-medium schools). This would also bias β_1 downward.

Three scenarios may instead result in an upward bias. First, given their higher poverty rates, it is possible that indigenous children in Quechua-medium schools are less likely to have attended school on the specific day that the tests used to measure academic achievement were administered, compared to indigenous children in Spanish-medium schools. This would cause an upward bias of β_1, since we would expect parents to prioritise education for their academically stronger children. However, Young Lives successfully administered both mathematics and language achievement tests to 94 per cent of the students selected to take part in the survey. They collected demographic and school information in most cases, even when a student did not take the achievement tests. Both mathematics and language test scores are available for 91 per cent of indigenous children in Quechua-medium schools and for 89 per cent of indigenous children in Spanish-medium schools. This difference is not significant and confirms that upward bias is unlikely because of different rates of attendance in Quechua-medium schools compared to Spanish-medium schools.

The second possibility for upward bias concerns the large number of missing observations in the data. As the Data section explains, demographic information for the peers was collected by consulting school records, and in many instances such information was not available. Information on parents' education and preschool attendance is available for 81 per cent of indigenous children in Spanish-medium schools, and 72 per cent of indigenous children in Quechua-medium schools, and the difference is significant at the 4 per cent level. If there is a correlation between availability of a student's demographic information and the student's household's socioeconomic status, then excluding those observations for whom there are no demographic data in the estimation may bias the parameter estimate upward; this since a larger proportion of the most disadvantaged indigenous children will be excluded in the

11 In an effort to reduce both positive selection bias and the possibility that the EIB programme impacts different indigenous children differently, we exclude the 33 non-Quechua speaking indigenous children from the sample. Including all children with parents who speak any native language in the definition of 'indigenous' only increases the size of the coefficient on *B* for the mathematics achievement, and does not affect the coefficients for language achievement.

Quechua-medium schools.[12] To address this possibility, we exclude the demographic variables and rerun the regressions on the resulting samples. As discussed in the Alternative specifications section, this does not change the qualitative results.

The third concern arises if indigenous children who attend Quechua-medium schools are more likely to drop out of school than indigenous children in Spanish-medium schools. This would bias β_1 upward for the same reason as above. As indicated in Table 2, indigenous children in Quechua-medium schools are significantly more likely to have repeated grades than indigenous children in Spanish-medium schools. In addition, there are fewer indigenous girls in Quechua-medium schools than in Spanish-medium schools and this difference is marginally significant. This may indicate a higher drop-out rate among indigenous children in Quechua-medium schools. However, Peru has a 98 per cent primary education completion rate (Crouch 2007). Evidence suggests that EIB education does not affect school dropout in Peru (Rodriguez Lozano 2012), and research from Guatemala and Mexico show that bilingual schools are better at retaining indigenous students (Parker et al. 2005; Marshall 2011). It is therefore likely that the higher drop-out rate among indigenous children in Quechua-medium schools is because of higher poverty rates among indigenous children, and not linked to the language of instruction per se. However, given the relationship between poverty and Quechua-medium school attendance, this may still bias our results. We are unable to account for this and recognise that it is a potential caveat in our analysis.

Given these selection considerations, there is little evidence that our estimate of the effect of Quechua-medium instruction on academic achievement would be biased upward. There is convincing evidence that the estimate could be downward biased. While recognising the caveats implied by one period cross-sectional data when determining causal relationships between school quality indicators and academic achievement, we argue that we have stronger evidence that our estimate of β_1 represents a lower bound.

12 The fact that information is more often available for indigenous children in Spanish-medium schools than for those in Quechua-medium schools would seem to suggest that there is a correlation between availability of information and a student's socioeconomic status. However, it is also possible that schools with fewer resources are less able to collect information of students in general, without this being caused by the socioeconomic status of the child in itself. If this is the case, then more missing observations among children in Quechua-medium schools would not bias the results.

6. Results

Table 4 presents the results for mathematics test scores. Column 1 shows that, when we only control for indigenous status, indigenous children in Quechua-medium schools have a negative parameter estimate but with a large standard error. This suggests that in terms of mathematics achievement, students in Quechua-medium schools do not differ from their peers in Spanish-medium schools. However, when we control for all variables specified for the model in column 2, indigenous children in Quechua-medium schools achieve a mathematics score 0.544 standard deviations higher than indigenous children in Spanish-medium schools. This corresponds to 65 per cent of the difference in mathematics achievement between indigenous and non-indigenous children reported in Table 1. The coefficient is significant at the 1 per cent level. As discussed above, we consider these parameter estimates to be a lower bound because of the suspected direction of possible selection bias into Quechua-medium schools. As such, these estimates suggest that Quechua-medium schools are very likely beneficial for indigenous children's mathematics achievement.

Table 5 shows the results for language test scores. When we only control for indigenous status, indigenous children in Quechua-medium schools score 0.289 standard deviations worse than their counterparts in Spanish-medium schools, and this is weakly significant at the 10 per cent level. When controlling for all variables specified in the model, as in column 2, we get a positive parameter estimate but this effect is not statistically significant. However, given that these estimates are lower bounds even a zero estimate is an important result. This result suggests that Quechua-medium schools are helping the generally weaker students in these schools catch up with their stronger student peers in Spanish-medium schools. Especially given that the tests were conducted in Spanish, the Quechua-medium students start out at a larger language test score deficit than mathematics score deficit. In addition, a zero estimate for the language scores suggests that indigenous children in Quechua-medium schools are not disadvantaged compared to their peers in Spanish-medium schools in terms of Spanish language ability. This is one goal of the EIB programme in Peru, and it counters the possible fear that Quechua-medium instruction will compromise children's Spanish acquisition.

Table 4. *Effect of Quechua-medium education on mathematics z-scores*

Variable	(1)	(2)
Quechua-medium school	-0.064 (0.154)	0.544*** (0.097)
Indigenous	-0.816*** (0.071)	-0.118** (0.052)
Female		-0.105** (0.050)
Age		-0.007 (0.031)
Preschool		0.213*** (0.063)
Repeated grade		-0.142* (0.079)
No siblings		0.138** (0.067)
Mother 1–5 yrs edu		0.073 (0.113)
Mother 6–11 yrs edu		0.187* (0.102)
Mother post-secondary edu		0.426*** (0.111)
Father 1–5 yrs edu		0.135 (0.122)
Father 6–11 yrs edu		0.200* (0.102)
Father post-secondary edu		0.304** (0.136)
Headteacher post-secondary edu		0.108 (0.071)
Maths teacher yrs experience		0.005 (0.003)
Maths teacher female		0.122* (0.062)
Student–teacher ratio		0.022*** (0.006)
Rooms in school		0.014*** (0.004)
Private		0.456*** (0.129)
Full grade school		-0.096 (0.106)
Rural		-0.264** (0.124)
School-level wealth controls	*No*	*Yes*
Constant	0.176*** (0.030)	-1.425** (0.652)
Observations	1,343	1,343
R-squared	0.116	0.380

Note: Bootstrapped robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The level of significance remains when clustering standard errors according to sentinel sites.
All regressions include controls for grade.

Table 5. *Effect of Quechua-medium education on language z-scores*

Variable	(1)	(2)
Quechua-medium school	-0.289*	0.184
	(0.153)	(0.165)
Indigenous	-0.842***	-0.249***
	(0.077)	(0.092)
Female		0.061
		(0.043)
Age		-0.063
		(0.041)
Preschool		0.161**
		(0.069)
Repeated grade		-0.114**
		(0.056)
No siblings		0.008
		(0.053)
Mother 1–5 yrs edu		0.208**
		(0.097)
Mother 6–11 yrs edu		0.251**
		(0.116)
Mother post-secondary edu		0.517***
		(0.129)
Father 1–5 yrs edu		0.067
		(0.139)
Father 6–11 yrs edu		0.072
		(0.155)
Father post-secondary edu		0.196
		(0.140)
Headteacher post-secondary edu		0.089*
		(0.051)
Maths teacher yrs experience		-0.001
		(0.003)
Maths teacher female		0.104**
		(0.052)
Student–teacher ratio		0.012**
		(0.005)
Rooms in school		-0.004
		(0.004)
Private		0.216**
		(0.106)
Full grade school		0.108
		(0.076)
Rural		-0.085
		(0.107)
School-level wealth controls	No	Yes
Constant	0.194***	-0.747
	(0.025)	(0.622)
Observations	1,343	1,343
R-squared	0.143	0.440

Note: Bootstrapped robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The level of significance remains when clustering standard errors according to sentinel sites.
All regressions include controls for grade.

In the fully specified model in column 2 in both Tables 4 and 5, the signs of the coefficients on the explanatory variables that affect test scores significantly are generally consistent across the mathematics and language tests, and correspond to a priori expectations. Indigenous status decreases mathematics achievement by 0.118 standard deviations, and language achievement by 0.249 standard deviations. This may imply that family wealth and school quality do not account for all the disadvantages that indigenous children face. Female children score 0.105 standard deviations worse on the mathematics test, but not significantly differently from boys on the language test. Since we do not explicitly control for household wealth and historic variables, we expect other control variables to be picking up effects of other things related to them. These coefficients should therefore be interpreted with caution and not as causal effects. Children who have attended preschool score 0.213 standard deviations better in mathematics, and 0.161 standard deviations better in language, while children who have repeated grades score 0.142 and 0.114 standard deviations worse on each test respectively. Children without any siblings score 0.138 standard deviations better in mathematics, while this has no effect on language achievement. Parents' levels of education are associated with higher achievement in both mathematics and language, although the effect of the father's education on language achievement is not significant.

Among the school- and teacher-level variables, attending a school whose headteacher has post-secondary education or having a female teacher have weakly significant but positive effects on both mathematics and language achievement. Measures of school size, student–teacher ratio, and number of classrooms in the school receive positive coefficients.

Our definition of indigenous status includes students who have one parent who speaks Spanish, and who are therefore likely to be bilingual in Quechua and Spanish. This means that some of the 'indigenous' children in Spanish-medium schools may not actually be linguistically disadvantaged in those schools. A more exclusive definition of indigenous status would be to only include children with two Quechua-speaking parents. Using this definition, the sample decreases to 1,301 observations since for several children, only information about the mother's and not the father's language was available. In this sample, there are 69 indigenous children in Quechua-medium schools, and 173 in Spanish-medium schools. Making this change increases the coefficient on Quechua-medium school to 0.636 and 0.274 standard deviations for mathematics and language achievement, respectively, and makes the coefficient for language achievement significant at the 10 per cent level. It is therefore possible that Quechua-medium schools do increase language ability (as measured by the test in Spanish), but only for indigenous children who are less likely to acquire Spanish skills outside of school.[13] [14]

The effects of attending a Quechua-medium school on mathematics and language achievement, as presented in Tables 4 and 5, are not sensitive to restricting the sample only to indigenous children. The results are also not sensitive to the specification of teacher and school characteristics[15] and only increase when including location controls.[16]

13 These results are available upon request.

14 Results are available in the reviewer's appendix.

15 Adding additional controls for full grade school, school shift, number of class hours per day, number of weeks that the school is open per year, and the mathematics teacher's level of education does not affect the coefficient on 'EIB school', decreases the coefficient on 'Teachers are trained in EIB teaching' slightly (-0.056), and does not affect the significance of either coefficient.

16 The schools in the final sample are located in seven different provinces and nine different departments. Actually, when including department controls, the effect of attending a Quechua-medium school on language achievement becomes significant at the 10 per cent level.

7. Alternative specifications

As discussed, there is reason to believe that our estimates are a lower bound. In this section we examine three important empirical concerns through alternative specifications. First, since the regressions presented in Tables 4 and 5 do not control completely for wealth effects at the household level, it is possible that unobserved economic or other advantages could drive the presented results. We use a sub-sample of the children for whom we have detailed household data to examine this concern.

Second, selection into indigenous-language schools is a major concern throughout this study. It is possible that particularly motivated Quechua-speaking parents would select into Quechua-medium schools, or they may place their stronger or weaker students into these schools. We examine the potential of selection in two ways: first using pre-school test data and second using an IV approach. Ideally we would like pre-school test scores for all children to examine this possibility. While we lack pre-school information on mathematics and language achievement for the entire sample, we do have this information for 514 children. Therefore, we conduct our analysis on a sub-sample of the children for whom pre-school cognitive achievement data are available. Lastly, we are concerned about the relatively small number of indigenous children. We can broaden our sample by dropping several limiting control variables and implementing the analysis on a broader sample with fewer controls. These three concerns are investigated in this section using alternative specifications.

Tables 6 and 7 address the first two concerns, using the 514 children for whom we have detailed household data and who took cognitive achievement tests before entering school. This sub-sample allows for a much richer analysis and can control for many more individual- and household-level variables, including household wealth. Using pre-school test scores we can more precisely test and control for ability between the two indigenous samples. In this sample of 514 students, 152 children are indigenous and only 40 of those indigenous children attended Quechua-medium schools. Given the small size of the sample, and in particular the small number of children in the 'treatment group', analysis on this sample cannot be considered as conclusive. However, it can give us more information about the magnitude of the potential selection bias in our sample. The children in the sub-sample attend the full range of eight Quechua-medium schools attended by children in the full sample.

Table 6. *Young Lives Younger Cohort children only: CDA and mathematics z-scores*

Variable	(1) Maths z-score	(2) CDA z-score	(3) Maths z-score	(4) CDA z-score	(5) Maths z-score	(6) CDA z-score
Quechua-medium school	0.443**	0.049	0.360**	-0.069	0.506**	0.022
	(0.194)	(0.224)	(0.180)	(0.200)	(0.197)	(0.219)
Mother speaks Quechua	-0.063	-0.005	-0.112	0.047	-0.044	-0.025
	(0.102)	(0.123)	(0.093)	(0.110)	(0.098)	(0.125)
CDA scores					0.132***	
					(0.045)	
Female	-0.073	0.028	-0.080	0.034	-0.076	0.039
	(0.073)	(0.080)	(0.078)	(0.079)	(0.076)	(0.082)
Age when took maths test	0.024	0.000	0.017		0.003	0.031
	(0.080)	(0.086)	(0.083)		(0.081)	(0.088)
Age when took CDA				0.048***		
				(0.009)		
Preschool	0.224*	0.315**	0.224*	0.328***	0.197*	0.310**
	(0.121)	(0.131)	(0.117)	(0.117)	(0.118)	(0.131)
Repeated grade	-0.090	0.173	-0.020		-0.107	0.214
	(0.150)	(0.174)	(0.155)		(0.150)	(0.174)
No siblings	0.089	-0.090				
	(0.103)	(0.108)				
Mother 1–5 education	-0.097	0.104	-0.207	0.087	-0.061	-0.007
	(0.165)	(0.211)	(0.164)	(0.191)	(0.169)	(0.210)
Mother 6–11 edu	0.106	0.095	-0.077	0.039	0.103	-0.013
	(0.173)	(0.211)	(0.175)	(0.195)	(0.174)	(0.215)
Mother higher edu	0.389*	0.421*	0.281	0.289	0.362*	0.276
	(0.206)	(0.236)	(0.215)	(0.226)	(0.209)	(0.240)
Father 1–5 edu	0.260	0.358**	0.316*	0.322	0.150	0.420**
	(0.198)	(0.180)	(0.178)	(0.196)	(0.186)	(0.193)
Father 6–11 edu	0.150	-0.020	0.196	-0.040	0.109	-0.049
	(0.169)	(0.157)	(0.151)	(0.178)	(0.156)	(0.176)
Father higher edu	0.324	-0.012	0.366**	-0.052	0.240	-0.074
	(0.198)	(0.184)	(0.183)	(0.204)	(0.189)	(0.203)
Rural	-0.313**	0.260	-0.276**	0.219	-0.365**	0.269
	(0.147)	(0.185)	(0.122)	(0.136)	(0.144)	(0.177)
Household- and child-level controls[a]	*No*	*No*	*Yes*	*Yes*	*Yes*	*Yes*
School controls[b]	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*
School-level wealth controls[c]	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*
Constant	-1.618	-3.001***	-1.438*	-4.317***	-1.264	-2.988***
	(1.021)	(1.010)	(0.816)	(0.616)	(1.036)	(1.050)
Observations	514	514	514	514	514	514
R-squared	0.411	0.319	0.360	0.285	0.439	0.332

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The first two columns present the results for the exact identification presented in Table 4. Columns 3 and 4 present results for a specification which is more 'ideal' to explain the CDA scores, including household-level variables but not school-level variables, since the CDA test was taken before the child started school. Columns 4 and 5 present the results for mathematics scores using the more 'ideal' specification including household controls, with and without the school-level controls presented in Table 1.

a) Household and child level controls include: number of hours the child spends on market or agricultural work, number of hours the child spends on domestic work, the number of siblings that live in the household, the child's BMI in 2009 and in 2006, dummy variables for whether the mother perceived the child as 'small' or 'very small' when the child was born, the number of books in the household, whether the household owns a dictionary and household-level measures of wealth and household quality in 2006 and 2009.

b) School controls include the same school and classroom level variables as presented in Tables 4 and 5.

c) The school-level wealth controls are the same as those presented in Table 1, and included in the regressions presented in Tables 4 and 5.

Table 7. *Young Lives Younger Cohort children only: PPVT and language z-scores*

Variable	(1) Language z-score	(2) PPVT z-score	(3) Language z-score	(4) PPVT z-score	(5) Language z-score	(6) PPVT z-score
Quechua-medium school	0.225	0.089	0.030	0.115	0.194	0.170
	(0.195)	(0.136)	(0.115)	(0.181)	(0.187)	(0.128)
Mother speaks Quechua	-0.222*	0.058	0.154*	-0.199**	-0.215*	0.052
	(0.114)	(0.094)	(0.079)	(0.099)	(0.111)	(0.096)
PPVT scores					0.234***	
					(0.054)	
Female	0.016	-0.044	-0.065	0.004	0.017	-0.038
	(0.072)	(0.062)	(0.059)	(0.071)	(0.072)	(0.063)
Age when took language test	-0.055	0.202***		-0.072	-0.112	0.221***
	(0.078)	(0.059)		(0.077)	(0.079)	(0.061)
Age when took PPVT			0.072***			
			(0.007)			
Preschool	0.169	0.151*	0.128*	0.225**	0.139	0.158*
	(0.113)	(0.084)	(0.073)	(0.105)	(0.105)	(0.082)
Repeated grade	-0.296*	0.015		-0.275	-0.278	0.005
	(0.169)	(0.105)		(0.175)	(0.169)	(0.106)
No siblings	0.030	0.002				
	(0.091)	(0.090)				
Mother 1–5 yrs education	0.002	-0.031	0.031	0.001	0.016	-0.055
	(0.143)	(0.131)	(0.121)	(0.141)	(0.145)	(0.137)
Mother 6–11 edu	0.112	0.087	0.092	0.067	0.061	0.047
	(0.152)	(0.140)	(0.127)	(0.160)	(0.157)	(0.141)
Mother higher edu	0.486***	0.671***	0.656***	0.446**	0.315	0.591***
	(0.179)	(0.182)	(0.168)	(0.188)	(0.193)	(0.182)
Father 1–5 yrs edu	0.517***	0.173	0.156	0.540***	0.492***	0.189
	(0.197)	(0.149)	(0.137)	(0.177)	(0.190)	(0.153)
Father 6–11 yrs edu	0.280*	0.188	0.190	0.289**	0.253*	0.138
	(0.168)	(0.139)	(0.133)	(0.146)	(0.153)	(0.144)
Father higher edu	0.394**	0.166	0.167	0.384**	0.312*	0.088
	(0.190)	(0.168)	(0.160)	(0.169)	(0.175)	(0.171)
Rural	-0.004	-0.283**	-0.161*	-0.187	0.066	-0.281**
	(0.139)	(0.135)	(0.092)	(0.116)	(0.132)	(0.125)
Household- and child-level controls[a]	*No*	*No*	*Yes*	*Yes*	*Yes*	*Yes*
School controls[b]	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*
School-level wealth controls[c]	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*
Constant	-0.106	-3.703***	-5.766***	0.179	0.528	-3.687***
	(0.864)	(0.782)	(0.490)	(0.768)	(0.849)	(0.806)
Observations	514	514	514	514	514	514
R-squared	0.458	0.609	0.623	0.445	0.497	0.626

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The first two columns present the results for the exact identification presented in Table 4. Columns 3 and 4 present results for a specification which is more 'ideal' to explain the PPVT scores, including household-level variables but not school-level variables, since the PPVT test was taken before the child started school. Columns 4 and 5 present the results for mathematics scores using the more 'ideal' specification including household controls, with and without the school-level controls presented in Table 1.

a) Household- and child-level controls include number of hours the child spends on market or agricultural work, number of hours the child spends on domestic work, the number of siblings that live in the household, the child's BMI in 2009 and in 2006, dummy variables for whether the mother perceived the child as 'small' or 'very small' when the child was born, the number of books in the household, whether the household owns a dictionary and household-level measures of wealth and household quality in 2006 and 2009.

b) School controls include the same school- and classroom-level variables as presented in Tables 4 and 5.

c) The school-level wealth controls are the same as those presented in Table 1, and included in the regressions presented in Tables 4 and 5.

In the 2006 Young Lives household round (Round 2), about one year before the children entered school, they were administered the Cognitive Development Assessment (CDA), which focuses on quantitative ability, and the Peabody Picture Vocabulary Test (PPVT), which tests language achievement. Our strategy is to replace the mathematics and language scores used as dependent variables in the regressions in Tables 4 and 5 with the CDA and PPVT scores.[17] Our null hypothesis of 'no selection' is tested by the coefficient on Quechua-medium schools in the regressions, using CDA and PPVT scores as dependent variables. Firstly, as a means to establish a comparison, column 1 in Table 6 shows the exact same regression (on the contemporary mathematics score) as in Table 4 but using only this sub-sample. We estimate a positive coefficient of 0.443 for the mathematics z-score, which is comparable, but slightly smaller and significant only at the 5 per cent level, to the parameter estimate on Quechua-medium school presented in Table 4. If it is true that Quechua-speaking parents do not place their particularly high-achieving children in Quechua-medium schools, we would expect either negative or zero coefficients on the Quechua-medium school parameter estimates when we use the pre-school tests as dependent variables. Column 2 in Table 6 shows that using this sample there is no difference between the CDA test scores (the pre-school mathematics score) of students who attended a Spanish-medium school versus those who attended a Quechua-medium school, conditional on the same controls as in column 1.

In order to explain variation in the CDA scores, it would make more sense to specify a model which does not take account of the school-level variables from the school round, given that this was a pre-school test, but which does include household- and child-level variables from the 2006 survey round. When such a model is used (Table 6, columns 3 and 4), 'Quechua-medium school' still positively affects the mathematics z-scores obtained during the school round, albeit with a smaller coefficient of 0.36, but 'Quechua-medium school' does not have any explanatory power on the CDA scores using this specification.

Column 5 in Table 6 shows that when we control for CDA scores and the school-level variables specified for the results in Table 4, the model still estimates a positive and significant parameter on Quechua-medium education for the mathematics z-scores. The size of this coefficient is 0.506, which is very close to that obtained for the entire sample. Column 6 in Table 6 shows that 'Quechua-medium school' does not have any explanatory power on the CDA scores when controlling for all variables included in the regression in column 5. In addition, including additional controls only decreases the size of the estimated coefficient. This suggests that under several specifications (columns 2, 4 and 6 in Table 6) there was no difference in quantitative ability before the indigenous students entered school. As such, we cannot reject the null hypothesis of 'no selection' in the case of CDA scores. However the positive and significant effect on the mathematics test scores obtained during the school round is consistently positive and significant under these various specifications and in this sub-sample.

We conduct a similar analysis for language ability in Table 7. We compare students' performance in the PPVT, administered before the students entered school, and the language test they took after several years in school. Column 1 in Table 7 shows that the parameter estimate on 'Quechua-medium school' is close to that obtained for the entire

17 The PPVT has been shown to measure scholastic aptitude, while mixed results have been obtained for the correlation between the PPVT and intelligence tests (Spreen and Strauss 2006). The CDA test administered to the children was developed by the International Evaluation Association in order to test young children's quantitative ability (Cueto et al. 2009).

sample, but not significant. Column 2 shows that the model estimates a parameter that is positive but not statistically different from zero on 'Quechua-medium school' when the PPVT scores are the dependent variable. Since the standard error for the language z-scores (column 1) is smaller than the coefficient, it is possible that there is a weak and positive language effect of Quechua-medium schools that we are not capturing, given the size of our sample. This indicates that at the very least, students in Quechua-medium schools are not falling behind in terms of language ability. Columns 3, 4, 5 and 6 in Table 7 show the same analysis as for the quantitative achievement in Table 6. Both language z-scores and PPVT scores produce positive but insignificant parameter estimates for Quechua-medium schools.[18]

This further implies that there is no evidence that indigenous children who attend Quechua-medium schools had superior cognitive ability prior to entering school, as compared to indigenous children who did not attend Quechua-medium schools. This further substantiates that our results are likely a lower bound, but that the true parameter estimate may be closer to this lower bound than previous analysis might have suggested.

As an additional check on selection we implement a two-stage least squares model to account for the potential violation of the assumption that $E(X|e)=0$ arising from selection issues. Finding a suitable instrument for Quechua-medium education is complicated by the fact that placement of Quechua-medium schools is associated with indigenous status, which in Peru is related to socioeconomic status and poverty. These factors also affect academic achievement. We use the percentage of indigenous children in the child's school as an instrument. To be an effective instrument we would like this variable to explain the language of instruction in the school without influencing test scores. Schools with more indigenous children are more likely to be Quechua-medium schools, and therefore the proportion of indigenous children in the school is positively related with Quechua-medium school attendance. We need to assume that that proportion of indigenous children does not influence test scores independently of socioeconomic controls. There are several potential problems with this instrument: there is some literature from Latin America which attempts to measure the 'peer effects' of attending schools with many indigenous peers (Sakellariou 2008). Although inconclusive, this literature argues that having indigenous peers may affect academic achievement, independently of socioeconomic and wealth controls. In order to accept the proportion of indigenous children as an instrument for this research, we would have to claim that, controlling for all relevant variables, the proportion of indigenous children in the school does not have any independent effect on individual academic achievement.

18 Additional regressions show that controlling for both CDA and PPVT scores when explaining the mathematics or language scores obtained during the school round does not change the effect that Quechua-medium schools have on those scores (not included).

Table 8. *IV estimates: proportion of indigenous children in the school*

Variable	Maths z-score		Language z-score	
	Whole sample (1)	Indigenous (2)	Whole sample (3)	Indigenous (4)
Quechua-medium school	0.676	1.351**	0.084	0.747
	(0.445)	(0.529)	(0.487)	(0.512)
Indigenous	-0.127	-	-0.240**	-
	(0.081)	-	(0.097)	-
Female	-0.103**	-0.136	0.061	0.127
	(0.045)	(0.097)	(0.043)	(0.112)
Age	-0.008	-0.043	-0.062*	-0.124**
	(0.031)	(0.041)	(0.035)	(0.059)
Preschool	0.215***	0.342**	0.154**	0.199
	(0.074)	(0.157)	(0.076)	(0.147)
Repeated grade	-0.138*	-0.065	-0.114	-0.009
	(0.075)	(0.126)	(0.077)	(0.141)
No siblings	0.131**	0.305	0.002	0.167
	(0.066)	(0.202)	(0.060)	(0.181)
Mother 1–5 yrs edu	0.085	-0.017	0.196*	0.016
	(0.106)	(0.152)	(0.112)	(0.169)
Mother 6–11 yrs edu	0.199*	0.194	0.238**	0.211
	(0.116)	(0.194)	(0.118)	(0.220)
Mother post-secondary edu	0.444***	0.930**	0.508***	0.438
	(0.140)	(0.395)	(0.138)	(0.440)
Father 1–5 yrs edu	0.143	0.042	0.06	0.25
	(0.123)	(0.193)	(0.132)	(0.196)
Father 6–11 yrs edu	0.21	-0.113	0.065	0.263
	(0.130)	(0.236)	(0.138)	(0.233)
Father post-secondary edu	0.304**	-0.167	0.183	0.382
	(0.145)	(0.365)	(0.147)	(0.337)
Headteacher post-secondary edu	0.111*	-0.048	0.09	-0.001
	(0.062)	(0.208)	(0.057)	(0.225)
Maths / language teacher yrs experience	0.005	-0.012	0.000	-0.015*
	(0.004)	(0.008)	(0.003)	(0.009)
Maths / language teacher female	0.120**	0.297*	0.111**	0.223
	(0.052)	(0.175)	(0.054)	(0.175)
Student–teacher ratio	0.022***	-0.01	0.013**	-0.019
	(0.005)	(0.031)	(0.005)	(0.026)
Rooms in school	0.014***	-0.004	-0.004	-0.015
	(0.004)	(0.014)	(0.003)	(0.016)
Private	0.461***	0.488	0.228**	-0.071
	(0.115)	(0.465)	(0.100)	(0.459)
Full grade school	-0.087	-0.106	0.111	0.039
	(0.095)	(0.206)	(0.090)	(0.236)
Rural	-0.296**	-0.924**	-0.066	-0.438
	(0.136)	(0.365)	(0.141)	(0.355)
School-level wealth controls	*Yes*	*Yes*	*Yes*	*Yes*
Constant	-1.594***	-2.037**	-0.816*	-1.263
	(0.487)	(0.927)	(0.489)	(0.842)
Observations	1341	282	1341	282
R-squared	0.38	0.503	0.439	0.526

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
All regressions include controls for grade.

Table 8 shows that instrumenting on 'proportion of indigenous children in the school' does not change the qualitative results reported in Tables 4 and 5. The parameter estimate on 'Quechua-medium school' remains positive in all specifications and significant in the case of mathematics scores in the sample that is restricted to only indigenous children (columns 2 and 4). The qualitative results for the other explanatory variables correspond to those reported in Tables 4 and 5.

The third concern is the small sample of indigenous students in Quechua-medium schools in our primary analysis. We may expand the sample by excluding the variables with most missing observations. As discussed in the Data section, there are many missing observations in the parents' education variables. Dropping these from the regression is very likely to introduce omitted variable bias since we use parents' education to control for socioeconomic status and we do not have access to other household-level controls for wealth. Since children who attend Quechua-medium schools appear to be poorer, we would expect a smaller coefficient on 'Quechua-medium school' when dropping parents' education from the regressions. However, dropping the parental education variables increases the sample to 1,508 children, the number of indigenous children to 344 and the number of indigenous children in Quechua-medium school from 72 to 101. The results are presented in Table 9. The coefficient on Quechua-medium education for the mathematics scores decreases to 0.342 but is still significant at the 1 per cent level. The coefficient on Quechua-medium education for the language scores is zero when excluding controls for parents' education. These results provide reassurance that the results presented in Tables 4 and 5 are not due to some idiosyncrasy of the small sample, at least for the mathematics scores.

There is still potential for omitted variable bias: since the EIB programme is a government-sponsored programme, it is possible that these schools have access to other services and more support from the community. Qualitative evidence suggests, however, that Quechua-medium schools often lack sufficient resources to fully implement the programme (Garcia 2010; Montoya Rojas 2001; DIGEIBIR 2005; Kudó 2004; Trapnell 2003). Still, we test the hypothesis that the effect of attending a Quechua-medium school on indigenous students' achievement presented in Tables 4 and 5 is explained by additional community, parental and state support,[19] teachers' resources,[20] superior quality of the headteacher's management,[21] or personnel, materials and other resources not accounted for in the main estimations,[22] by

19 The variables used to measure additional community and state support are: dummy variables for whether there is a community organisation that helps with the management of the school, if the school has received a visit from the Local Education Management Unit (UGEL), and whether the school has received a visit from the Regional Office of Education (DRE), whether the school receives private or public support, whether the school has a parents' association; and continuous variables of the frequency of visits from educational experts, meetings in the parents' association, and annual payment to the parents' association.

20 Variables used to measure teacher's support are: dummy variables for whether there is a teachers' association and an institutional education council (CONEI), a continuous variable of how often the teachers' association meets, and dummy variables indicating whether the mathematics (language) teacher has received training during the past two years, whether the mathematics (language) teacher has access to teacher assistance and whether the mathematics (language) teacher entered the teachers' professional career.

21 Variables used to measure the quality of management are: dummy variables for the frequency of headteacher meeting with the teachers and whether the headteacher has been absent from the school during the past 30 days; and eleven continuous variables measuring the headteacher's managerial qualities, as indicated by the mathematics teacher (the mathematics teacher answered eleven questions about the headteacher in the form 'In meetings, the headmaster discusses educational goals with teachers: 1: never, 2: seldom, 3: quite often, 4: very often').

22 The variables included measuring additional resources are: dummy variables for whether the school offers lunch and breakfast, and whether the school has a nurse, a psychologist, computer lab personnel and/or a librarian, and continuous variables measuring the number of administrative personnel and the number of teacher's aids.

including variables accounting for these factors in the full model. All of these additional estimations yield the same result of positive and significant parameter estimates on Quechua-medium schools for mathematics and positive (or zero) and weakly significant for language.[23]

Table 9. *OLS estimates excluding parents' education*

Variable	(1) Math z-score	(2) Language z-score
Quechua-medium school	0.342***	-0.006
	(0.127)	(0.128)
Indigenous	-0.143**	-0.300***
	(0.070)	(0.046)
Female	-0.128***	0.038
	(0.048)	(0.049)
Age	-0.016	-0.062
	(0.028)	(0.041)
Preschool	0.246***	0.250***
	(0.062)	(0.069)
Repeated grade	-0.217***	-0.163
	(0.083)	(0.104)
No siblings	0.146*	0.057
	(0.085)	(0.039)
Headteacher post-secondary edu	0.123**	0.063
	(0.061)	(0.056)
Maths teacher yrs experience	0.000	-
	(0.004)	
Maths teacher female	0.117*	-
	(0.062)	
Language teacher yrs experience	-	-0.002
		(0.002)
Language teacher female	-	0.086
		(0.053)
Student–teacher ratio	0.021***	0.012**
	(0.006)	(0.005)
Rooms in school	0.014***	-0.001
	(0.004)	(0.004)
Private	0.513***	0.308***
	(0.107)	(0.072)
Full grade school	-0.048	0.105
	(0.051)	(0.072)
Rural	-0.268***	-0.084
	(0.097)	(0.094)
Constant	-1.117*	-0.197
	(0.645)	(0.667)
School-level wealth controls	Yes	Yes
Observations	1,508	1,508
R-squared	0.381	0.431

Note: Bootstrapped robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

23 Results are available in the reviewer's appendix.

8. Conclusion

This study investigates the effect of Quechua-medium instruction on Peruvian indigenous children's academic achievement. The results suggest that indigenous children (children whose mother is a native Quechua speaker) who attend Quechua-medium schools (those schools whose teachers were trained in bilingual teaching) score 0.54 standard deviations higher in mathematics than indigenous children who attend Spanish-medium schools. This finding is not sensitive to the definition of indigenous status or the specification of control variables, and is unlikely to be driven by selection bias. Results are also robust to the inclusion of several controls measuring community and state support, teachers' resources, the quality of the headteacher's management, or additional personnel, materials and other resources. Our study finds no robust effect of attending a Quechua-medium school on language achievement; however some specifications suggest a weakly significant and positive effect. Importantly, we find that children in Quechua-medium schools are not losing ground in language ability compared to their peers in Spanish-medium schools.

The results presented have several implications for the EIB programme in Peru. Firstly, this provides a rigorous analysis of the programme's impact on indigenous students' academic achievement, paying careful attention to the possibility of selection bias. According to our results, Quechua-medium instruction has the potential to contribute significantly to indigenous students' academic achievement, and to reduce the indigenous test score gap, in particular for mathematics and possibly for language. It should be noted that despite the positive results, there remain obstacles to implementing the programme, as discussed above. Fifteen of the sixteen EIB headteachers that Young Lives surveyed agreed that bilingual teaching materials were lacking, and all agreed that more bilingual teacher training was needed. In 14 of the 16 EIB schools, a lack of support from parents was an obstacle to implementation. This suggests that with sufficient resources, Quechua-medium instruction may benefit indigenous Peruvian children to an even greater extent than suggested by the results we present.

Several other Latin American countries with large indigenous populations implement their own versions of the EIB programme, with varying degrees of community and parental involvement (Garcia 2010). To our knowledge, the economic literature has as of yet not analysed these programmes' results, probably due to data limitations and methodological barriers. Comparative analysis of the different systems could reveal which style of implementation increases academic achievement the most.

In order to investigate the effect of bilingual education on language and mathematics abilities more conclusively, a large, well-designed randomised control trial is needed. Under these experimental conditions policymakers could be more confident that positive results of indigenous language instruction were due to the mode of instruction rather than confounding factors. This research presents suggestive evidence that Quechua-medium instruction is beneficial for indigenous children but given the many caveats discussed, can only present this evidence as suggestive and not conclusive.

References

Benson, Carolyn J. (2010) 'Real and Potential Benefits of Bilingual Programmes in Developing Countries', *International Journal of Bilingual Education and Bilingualism* 5.6: 303–17

Benson, Carolyn J. (2000) 'The Primary Bilingual Education Experiment in Mozambique, 1993 to 1997', *International Journal of Bilingual Education and Bilingualism* 3.3: 149–66

Borooah, Vani K. (2012) 'Social Identity and Educational Attainment: The Role of Caste and Religion in Explaining Differences between Children in India', *Journal of Development Studies* 48.7: 887–903

Bradley, Steve, Mirko Draca, Colin Green and Gareth Leeves (2007) 'The Magnitude of the Educational Disadvantage of Indigenous Minority Groups in Australia', *Journal of Population Economics* 20: 547–69

Card, David and Alan Krueger (1992) 'Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States', *The Journal of Political Economy* 100.1: 1–40

Case, Anne and Angus Deaton (1999) 'School Inputs and Educational Outcomes in South Africa', *The Quarterly Journal of Economics* 114.3: 1047–84

Cawley, John, James Heckman and Eward Vytlacil (2001) 'Three Observations on Wages and Measured Cognitive Ability', *Labour Economics* 8: 419–42

Census Nacional, Peru (2007) 'Censos Nacionales 2007 XI de Polblación y VI de Vivienda', Instituto Nacional de Estadistisca e Informatica, http://censos.inei.gob.pe/cpv2007/tabulados/# (accessed 1 February 2014)

Clotfelter, Charles T., Helen F. Ladd and Jacob L. Vigdor (2009) 'The Academic Achievement Gap in Grades 3 to 8', *The Review of Economics and Statistics* 91.2: 398–419

Cordova, Elizabeth Rosales (2012) 'Bilingual Education in Peru', Niños del Milenio Boletín 6 April, Lima: Niños del Milenio

Cortina, Regina (2014) 'Introduction' in Regina Cortina (ed.) *The Education of Indigenous Citizens in Latin America*, Bristol: Multilingual Matters

Crouch, Luis (2007) *Toward High-quality Education in Peru: Standards, Accountability, and Capacity Building*, Washington, DC: World Bank

Cueto, Santiago, Juan León, Gabriela Guerrero and Ismael Muñoz (2009) *Psychometric Characteristics of Cognitive Development and Achievement Instruments in Round 2 of Young Lives*, Technical Note, Oxford: Young Lives

Cueto, Santiago and Walter Secada (2003) 'Eficacia Escolar en Escuelas Bilingues en Puno Peru', *Revista Electronica Iberoamericana sobre Calidad, Eficacia y Cambio en Educacion* 1.1: 1–23

Currie, Janet and Duncan Thomas (1999) 'Does Head Start Help Hispanic Children?', *Journal of Public Economics* 74:2: 235–62

DIGEIBIR – Dirección General de Educación Intercultural Bilingüe y Rural (2013) *Hacia una Educación Intercultural Bilingüe de Calidad Propuesta Pedagógica*, Lima: Ministry of Education, Peru

DIGEIBIR – Dirección General de Educación Intercultural Bilingüe y Rural (2005) *La Participación de los Pueblos Indígenas y Comunidades Rurales en el Proyecto de Educación en Áreas Rurales*, Lima: Ministry of Education, Peru

Enge, Kjell I. and Ray Chesterfield (1996) 'Bilingual Education and Student Performance in Guatemala', *International Journal of Educational Development* 16.3: 291–302

Enrique López, Luis (2014) 'Indigneous Intercultural Bilingual Education in Latin America: Widening Gaps between Policy and Practice' in Regina Cortina (ed.) *The Education of Indigenous Citizens in Latin America*, Bristol: Multilingual Matters

Escobal, Javier and Eva Flores (2008) *An Assessment of the Young Lives Sampling Approach in Peru*, Technical Note, Oxford: Young Lives

Fertig, Michael (2003) *Who's to Blame? The Determinants of German Students'*

Achievement in the PISA 2000 Study, IZA Discussion Paper 739, Bonn: Institute for the Study of Labor

Fischer, Stefanie and Christiana Stoddard (2013) 'The Academic Achievement of American Indians', *Economics of Education Review* 36: 135–52

Friesen, Jane and Brian Krauth (2010) 'Sorting, Peers, and Achievement of Aboriginal Students in British Columbia', *Canadian Journal of Economics* 43.4: 1273–301

Fryer, Roland G. and Steven D. Levitt (2006) 'The Black-White Test Score Gap Through Third Grade', *American Law and Economics Review* 8: 249–81

Fryer, Roland G. and Steven D. Levitt (2004) 'Understanding the Black-White Test Score Gap in the First Two Years of School', *Review of Economics and Statistics* 86.2: 447–64

Garcia, María Elena (2010) 'Rethinking Bilingual Education in Peru: Intercultural Politics, State Policy and Indigenous Rights', *International Journal of Bilingual Education and Bilingualism* 7.5: 348–67

Groff, Cynthia (2005) 'Evaluations of Bilingual and Mother-Tongue Programmes: Measures of Success and Means of Measurement', *Working Papers in Educational Linguistics* 20.2: 19–39

Glewwe, Paul (2002) 'Schools and Skills in Developing Countries: Education

Policies and Socioeconomics Outcomes', *Journal of Economic Literature* XL: 436–82

Glewwe, Paul, Sofya Krutikova and Caine Rolleston (2014) *Do Schools Reinforce or Reduce Learning Gaps between Advantaged and Disadvantaged Students? Evidence from Vietnam and Peru*, Working Paper 133, Oxford: Young Lives

Glewwe, Paul, Eric Hanushek, Sarah Humpage and Renato Ravina (2011) *School Resources and Educational Outcomes in Developing Countries: A Review of the Literature from 1990 to 2010*, NBER Working Paper, Cambridge, MA: National Bureau of Economic Research

Guerrero, Gabriela, Juan Leon, Elizabeth Rosales, Silvana Freire, Victor Saldarriaga and Santiago Cueto (2012) *Young Lives School Survey in Peru: Design and Initial Findings*, Working Paper 92, Oxford: Young Lives

Hanushek, Eric A. (1986) 'The Economics of Schooling: Production and Efficiency of Public Schools', *Journal of Economic Literature* 24.3: 1141–77

Hanushek, Eric A. and Steven G. Rivkin (2009) 'Harming the Best: How Schools Affect the Black-White Achievement Gap', *Journal of Policy Analaysis and Management* 28.3: 366–93

Hanushek, Eric A. and Ludger Woessmann (2012) 'Do Better Schools Lead to More Growth? Cognitive Skills, Economic Outcomes, and Causation', *Journal of Economic Growth* 17: 267–321

Hovens, Mart (2002) 'Bilingual Education in West Africa: Does it Work?', *International Journal of Bilingual Education and Bilingualism* 5.5: 249–66

Kertesi, Gábor and Gábor Kézdi (2011) 'The Roma/Non-Roma Test Score Gap in Hungary', *American Economic Review: Papers & Proceedings* 101.3: 519–25

Kudó, Inés (2004) 'La Educación Indígena en el Perú. Cuando la Oportunidad Habla Una Sola Lengua' in Donald R. Winkler and Santiago Cueto (eds) *Etnicidad, Raza, Género y Educación en América Latina*, Santiago: PREAL

Lavoie, Constance (2008) '"Hey, Teacher, Speak Black Please": The Educational Effectiveness of Bilingual Education in Burkina Faso', *International Journal of Bilingual Education and Bilingualism* 11.6: 661–77

Leigh, Andrew and Xiaodong Gong (2009) 'Estimating Cognitive Gaps Between Indigenous and non-Indigenous Australians', *Education Economics* 17.2: 239–61

López, Luis Enrique (2002) *'A ver, a ver... ¿Quién quiere salir a la pizarra? ¿Jumasti?*

¿Jupasti?' Cambios Iniciales en la Escuela Rural Bilingüe Peruana, Documento de Trabajo 15, Lima: Ministry of Education, Peru

Marshall, Jeffery H. (2011) 'School Quality Signals and Attendance in Rural Guatemala', *Economics of Education Review* 30: 1445–55

Marshall, Jeffery H. (2009) 'School Quality and Learning Gains in Rural Guatemala', *Economics of Education Review* 28.2: 207–16

McEwan, Patrick J. (2008) 'Can Schools Reduce the Indigenous Test Score Gap? Evidence from Chile', *Journal of Development Studies* 44.10: 1506–30

McEwan, Patrick J. (2004) 'The Indigenous Test Score Gap in Bolivia and Chile', *Economic Development and Cultural Change* 53.1: 157–90

McEwan, Patrick J. and Marisol Trowbridge (2007) 'The Achievement of Indigenous Students in Guatemalan Primary Schools', *International Journal of Educational Development* 27: 61–76

Meade, Ben (2012) 'A Mixed-Methods Analysis of Achievement Disparities in Guatemalan Primary Schools', *International Journal of Educational Development* 32: 575–89

Montoya Rojas, Rodrigo (2001) 'Limites e Possibilidades da Educação Bilíngüe Intercultural no Peru', *Revista Letras* 56: 13–31

Padilla, A.M. (2006) 'Second Language Learning: Issues in Research and Teaching' in P.A. Alexander and P.H. Winne (eds) *Handbook of Educational Psychology*, 2nd edition, New York: Routledge

Parker, Susan W., Luis Rubalcava and Graciela Teruel (2005) 'Schooling Inequality and Language Barriers', *Economic Development and Cultural Change* 54.1: 71–94

Patacchini, Eleonora and Yves Zenou (2009) 'On the Sources of the Black-White Test Score Gap in Europe', *Economic Letters* 102: 49–52

Rodríguez Lozano, Efraín (2012) 'Barreras Linüísticas en la Educación? La Influencia de la Lengua Materna en la Deserción Escolar', *Economia* 35.69: 83–151

Sakellariou, Chris (2008) 'Peer Effects and the Indigenous/non-Indigenous Early Test-Score Gap in Peru', *Education Economics* 16.4: 371–390

Slavin, Robert E. and Alan Cheung (2005) 'A Synthesis of Research on Language of Reading Instruction for Eglish Language Learners', *Review of Educational Research* 75.2: 247–84

Spreen, Otfried and Esther Strauss (2006) *A Compendium of Neuropsychological Tests: Administration, Norms and Commentary*, 3rd edition, Oxford: Oxford University Press

Todd, Petra E. and Kenneth I. Wolpin (2007) 'The Production of Cognitive Achievement in Children: Home, School, and Racial Test Score Gaps', *Journal of Human Capital* 1.1: 91–136

Todd, Petra E., and Kenneth I. Wolpin (2003) 'On the Specification and Estimation of the Production Function for Cognitive Achievement', *The Economic Journal* 113.485: F3–F33

Trapnell, Lucy A. (2003) 'Some Key Issues in Intercultural Bilingual Education Teacher Training Programmes – As Seen from A Teacher Training Programme in the Peruvian Amazon Basin', *Comparative Education* 39.2: 165–83

Trudell, Barbara (2005) 'Language Choice, Education and Community Identity', *International Journal of Educational Development* 25: 237–51

Truong, Natasha (2012) ' Language of Instruction: Unlocking Effectiveness of Education and Sustainable Development in Sub-Saharan Africa', *International Education* 42.1: 6–21

Walter, Stephen L. and Diane E. Dekker (2011) 'Mother Toungue Instruction in Lubuagan: A Case Study from the Philippines', *International Review of Education* 57: 667–83

Reviewer appendix

Table A. *'Indigenous' defined as having two Quechua-speaking parents*

Variable	(1) Maths z-score	(2) Language z-score
Quechua-medium school	0.636***	0.274*
	(0.146)	(0.147)
Both parents speak Quechua	-0.108	-0.290***
	(0.080)	(0.086)
Female	-0.102**	0.060
	(0.045)	(0.043)
Age	-0.007	-0.065*
	(0.030)	(0.035)
Preschool	0.207***	0.158**
	(0.068)	(0.073)
Repeated grade	-0.147*	-0.127*
	(0.075)	(0.077)
No siblings	0.131*	0.003
	(0.067)	(0.061)
Mother 1–5 yrs education	0.071	0.230**
	(0.098)	(0.105)
Mother 6–11 yrs edu	0.180	0.260**
	(0.109)	(0.114)
Mother post-secondary edu	0.400***	0.527***
	(0.134)	(0.132)
Father 1–5 yrs edu	0.137	0.053
	(0.122)	(0.129)
Father 6–11 yrs edu	0.210	0.067
	(0.130)	(0.135)
Father post-secondary edu	0.367**	0.185
	(0.145)	(0.147)
Headteacher post-secondary edu	0.110*	0.087
	(0.063)	(0.058)
Maths teacher yrs experience	0.006	-
	(0.004)	
Maths teacher female	0.099*	-
	(0.052)	
Language teacher yrs experience	-	0.000
		(0.003)
Maths teacher female	-	0.088*
		(0.052)
Student–teacher ratio	0.023***	0.012**
	(0.005)	(0.005)
Rooms in school	0.015***	-0.002
	(0.004)	(0.004)
Private	0.454***	0.224**
	(0.115)	(0.099)
Full grade school	-0.095	0.092
	(0.096)	(0.092)
Rural	-0.265**	-0.092
	(0.105)	(0.105)
Constant	-2.035***	-0.870*
	(0.460)	(0.468)
School-level wealth controls	Yes	Yes
Observations	1,298	1,298
R-squared	0.385	0.443

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

All regressions include controls for school grade.

Three children who attended Quechua-medium schools, whose mothers, but not fathers, spoke Quechua, were deleted. This so that only 'indigenous' children attend Quechua-medium schools and we may identify the effect of Quechua-medium schools as in the primary results.

Table B. *Additional school-level controls*

Variable	(1) Maths z-score	(2) Maths z-score	(3) Maths z-score	(4) Maths z-score	(5) Language z-score	(6) Language z-score	(7) Language z-score	(8) Language z-score
Quechua-medium school	0.561***	0.566***	0.598***	0.548***	0.161	0.201	0.227	0.234*
	(0.140)	(0.141)	(0.145)	(0.140)	(0.142)	(0.143)	(0.154)	(0.141)
Indigenous	-0.118	-0.152**	-0.159**	-0.099	-0.227***	-0.255***	-0.268***	-0.242***
	(0.072)	(0.072)	(0.071)	(0.073)	(0.078)	(0.078)	(0.079)	(0.079)
Female	-0.101**	-0.108**	-0.090**	-0.107**	0.054	0.062	0.067	0.052
	(0.044)	(0.044)	(0.044)	(0.045)	(0.043)	(0.043)	(0.043)	(0.042)
Age	-0.001	-0.007	0.011	-0.007	-0.058*	-0.062*	-0.056	-0.063*
	(0.030)	(0.030)	(0.029)	(0.030)	(0.035)	(0.034)	(0.035)	(0.034)
Preschool	0.191***	0.208***	0.203***	0.216***	0.153**	0.158**	0.174**	0.167**
	(0.067)	(0.066)	(0.067)	(0.068)	(0.073)	(0.072)	(0.073)	(0.072)
Repeated grade	-0.132*	-0.147**	-0.152**	-0.145**	-0.109	-0.118	-0.118	-0.105
	(0.076)	(0.073)	(0.072)	(0.074)	(0.078)	(0.076)	(0.076)	(0.076)
No siblings	0.127*	0.137**	0.145**	0.147**	-0.002	0.011	0.007	0.005
	(0.066)	(0.066)	(0.067)	(0.067)	(0.060)	(0.060)	(0.061)	(0.061)
Mother 1–5 yrs edu	0.063	0.081	0.057	0.07	0.210**	0.212**	0.183*	0.214**
	(0.096)	(0.098)	(0.099)	(0.098)	(0.106)	(0.104)	(0.105)	(0.105)
Mother 6–11 Yrs edu	0.194*	0.193*	0.157	0.191*	0.254**	0.249**	0.211*	0.266**
	(0.107)	(0.107)	(0.108)	(0.108)	(0.113)	(0.112)	(0.113)	(0.113)
Mother post-secondary edu	0.404***	0.403***	0.349***	0.438***	0.503***	0.507***	0.454***	0.516***
	(0.131)	(0.132)	(0.131)	(0.132)	(0.132)	(0.131)	(0.131)	(0.131)
Father 1–5 yrs edu	0.146	0.161	0.121	0.137	0.059	0.06	0.067	0.058
	(0.120)	(0.123)	(0.110)	(0.124)	(0.131)	(0.129)	(0.128)	(0.129)
Father 6–11 yrs edu	0.242*	0.234*	0.185	0.201	0.08	0.073	0.076	0.061
	(0.126)	(0.130)	(0.118)	(0.131)	(0.136)	(0.135)	(0.133)	(0.134)
Father post-secondary edu	0.342**	0.332**	0.291**	0.300**	0.197	0.196	0.197	0.17
	(0.143)	(0.145)	(0.134)	(0.147)	(0.147)	(0.146)	(0.145)	(0.145)
Headteacher post-secondary edu	0.065	0.120*	0.11	0.104*	0.094	0.094	0.104	0.078
	(0.066)	(0.064)	(0.068)	(0.061)	(0.061)	(0.060)	(0.066)	(0.057)
Maths teacher yrs experience	0.002	0.007*	0.002	0.003				
	(0.004)	(0.004)	(0.004)	(0.004)				
Maths teacher female	0.090*	0.143***	0.056	0.096*				
	(0.051)	(0.052)	(0.052)	(0.051)				
Language teacher yrs experience					-0.001	0.001	0	-0.002
					(0.003)	(0.004)	(0.003)	(0.003)
Language teacher female					0.103**	0.116**	0.099*	0.104**
					(0.052)	(0.050)	(0.052)	(0.050)
Student–teacher ratio	0.024***	0.019***	0.025***	0.018***	0.013**	0.010*	0.011**	0.011**
	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Rooms in school	0.014***	0.011***	0.017***	0.019***	-0.004	-0.004	-0.003	0
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Private	0.142	0.508***	0.489***	0.319**	0.221	0.239**	0.209**	0.071
	(0.169)	(0.136)	(0.116)	(0.132)	(0.165)	(0.120)	(0.105)	(0.124)
Full grade school	-0.11	-0.103	-0.062	-0.180*	0.092	0.121	0.149	0.051
	(0.107)	(0.091)	(0.102)	(0.108)	(0.109)	(0.094)	(0.097)	(0.108)
Rural	-0.063	-0.208*	-0.117	-0.242**	-0.016	-0.076	-0.016	-0.019
	(0.111)	(0.109)	(0.108)	(0.107)	(0.112)	(0.109)	(0.113)	(0.112)
Constant	19.213***	-5.361*	-2.739***	-1.043**	3.198	-1.741	-1.355**	-0.671
	(5.386)	(2.882)	(0.532)	(0.515)	(5.288)	(2.980)	(0.565)	(0.513)
Wealth controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Support from community, state, parents	*Yes*	*No*	*No*	*No*	*Yes*	*No*	*No*	*No*
Additional support for teachers	*No*	*Yes*	*No*	*No*	*No*	*Yes*	*No*	*No*
Quality of school management	*No*	*No*	*Yes*	*No*	*No*	*No*	*Yes*	*No*
Personnel, materials and other resources	*No*	*No*	*No*	*Yes*	*No*	*No*	*No*	*Yes*
Observations	1343	1341	1343	1343	1343	1343	1343	1343
R-squared	0.397	0.389	0.411	0.386	0.445	0.441	0.449	0.446

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Bilingual Education in Latin America: Does Quechua-Medium Education Improve Peruvian Indigenous Children's Academic Achievement?

This study uses Peruvian school-level data from the Young Lives international study of childhood poverty to investigate the effect of Quechua-medium instruction on academic achievement. We estimate an education production function and find that indigenous children who attend Quechua-medium schools achieve mathematics scores 0.54 standard deviations higher than indigenous children who attend Spanish-medium schools. We find weak and inconclusive evidence that indigenous children who attend Quechua-medium schools attain higher language test scores. There is no evidence that these effects are caused by quantitative or language achievement prior to entering school. Our findings suggest that indigenous-language-medium education for Latin American indigenous children may play a role in ameliorating the indigenous test score gap.

Young Lives
An International Study of Childhood Poverty

About Young Lives

Young Lives is an international study of childhood poverty, involving 12,000 children in 4 countries over 15 years. It is led by a team in the Department of International Development at the University of Oxford in association with research and policy partners in the 4 study countries: Ethiopia, India, Peru and Vietnam.

Through researching different aspects of children's lives, we seek to improve policies and programmes for children.

Young Lives Partners

Young Lives is coordinated by a small team based at the University of Oxford, led by Professor Jo Boyden.

- *Ethiopian Development Research Institute, Ethiopia*
- *Pankhurst Development Research and Consulting plc*
- *Save the Children (Ethiopia programme)*
- *Centre for Economic and Social Sciences, Andhra Pradesh, India*
- *Save the Children India*
- *Sri Padmavathi Mahila Visvavidyalayam (Women's University), Andhra Pradesh, India*
- *Grupo de Análisis para el Desarollo (GRADE), Peru*
- *Instituto de Investigación Nutricional, Peru*
- *Centre for Analysis and Forecasting, Vietnamese Academy of Social Sciences, Vietnam*
- *General Statistics Office, Vietnam*
- *University of Oxford, UK*

Contact:
Young Lives
Oxford Department of International Development,
University of Oxford,
3 Mansfield Road,
Oxford OX1 3TB, UK
Tel: +44 (0)1865 281751
Email: younglives@younglives.org.uk
Website: www.younglives.org.uk

Young Lives
An International Study of Childhood Poverty