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## ACADEMIC PERFORMANCE OF PERUVIAN ELEMENTARY SCHOOL CHILDREN: THE CASE OF SCHOOLS IN LIMA AT THE 6<sup>TH</sup> GRADE

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### RESUMEN

El estudio que se informa examinó de qué manera el *rendimiento* académico en diversas áreas del aprendizaje tales como *ortografía*, *lectura* y *aritmética* estuvo asociado con diferentes variables relacionadas con niños (por ejemplo: género, inteligencia y edad). Asimismo, se consideraron algunas variables distales como estatus socioeconómico y tipo de colegio.

En el estudio participaron 1.129 niños que cursaban 6<sup>o</sup> grado de educación primaria en Lima Metropolitana (*Perú*). Los estudiantes completaron cuatro pruebas: En el área de lectura fueron examinados con un subtest de la prueba Procesos Lectores (PROLEC-SE) Lectura de Palabras y Pseudo - palabras (Cuetos & Ramos, 1999). En el área de Aritmética fueron evaluados con el Subtest de Facilidad Numérica de Ekstrom, French y Harman (1979) y en el caso de Ortografía se aplicó la Prueba de Rendimiento Ortográfico (Díoses, 2001). La variable inteligencia fue medida con la Prueba de Matri-

ces Progresivas de Raven (Raven, J., Raven, J.C. & Court, 2004).

Debido a la estructura jerárquica de los datos (estudiantes dentro de clases y clases dentro de escuelas) se aplicó *análisis multinivel* para cada variable académica (ortografía, lectura y aritmética).

Los resultados revelaron un gran impacto en primer lugar del tipo de escuela: los alumnos de escuelas privadas rindieron mejor que los de escuelas públicas en todas las áreas académicas; en segundo lugar, la variable inteligencia juega un rol esencial, cuanto mayor es el coeficiente intelectual del estudiante, mejor es el rendimiento académico, y parcialmente del género; las niñas mostraron un mejor desempeño en comparación con los niños en el área de ortografía. Se discuten en detalle algunas repercusiones pedagógicas.

*Palabras clave:* Rendimiento; Lectura; Aritmética; Ortografía; Análisis multinivel; Latino; Perú.

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## ABSTRACT

Education is in general the basis for development in any country in the world. In the educational field, several international assessments (Pisa, 2006) reflect the great gap that yet subsists among developing countries, in which the case of Peru is not an exception.

There have been many national and international academic achievement evaluations that examine the skills and knowledge of students not only in Peru but also in other *Latin American* countries in different academic domains. One of these examples is the Regional Comparative and Explanatory Study (LLECE), in which Peru participated, in order to evaluate and compare the *performance* achieved by Latin American students of 3<sup>rd</sup> and 6<sup>th</sup> grade in core areas like Language, Mathematics, and Natural Sciences. Peru ranks, together with other Latin countries, with scores below the average (Regional Office for Education of UNESCO, 2008). The low ranking of the Peruvian educational system carries heavy implications and consequences, especially to the intellectual and social development of learning disabled Peruvian children. Understanding the relation between academic performance and child development is of paramount importance.

The present study examines how *spelling, reading and arithmetic* performances are associated to various child variables (gender, intelligence, and age), and distal variables such as Socio-Economic Status (SES) or type of school. The subjects in the study were 1.129 elementary school children who were in the 6<sup>th</sup> grade (11 - 12 years old) in Metropolitan Lima, Perú. Children completed four different tests: In the reading area, the subtest of *Procesos Lectores* (PROLEC-SE; Cuetos & Ramos, 1999), Reading of Word and Pseudo-word; in the Arithmetic domain, the Number Facility from the Kit of Factor Referenced Cognitive Tests of Ekstrom, French, and Harman (1979) and in the spelling domain, the Spelling Achievement Test from Dioses (2001) was used. The Intelligence Quotient (IQ) was measured using Raven's Progressive Matrices Test (Raven, J., Raven, J.C., & Court, 2004, updated edition).

Some preliminary analyses were conducted beforehand in order to overview and examine the structure of the data. Following this, and because

of the hierarchical structure of the data (students within classes within schools) *multilevel* analyses were conducted.

Results showed, first and foremost, a great impact of (a) type of school, private schools performed better than in the public sector; (b) intelligence, another essential variable (the higher the IQ the better the academic achievement), and partially of (c) gender, girls showed prevalence over boys in spelling. Likewise, we did not encounter any significant results of socio-economic status in the multilevel analysis. Based on these results, some practical and pedagogical implications were discussed, such as the fundamental effort to bring the lower achievement group into average levels of learning with remedial work, otherwise these students will lack the requisite skills needed to fulfill their secondary school academic expectations. Notwithstanding, we have to point out some limitations such as the lack of data from rural zones that could prevent us from comparisons between rural and urban zones. Future work is necessary in order to investigate academic performance associated with other variables that might influence the child's development, such as parenting behavior or psychosocial factors.

*Key words:* Performance; Reading; Arithmetic; Spelling; Multilevel; Childhood; Latin.

Education is undoubtedly the basis of development in any country in the world and represents the real motor of any serious economic and social policy. In the educational field various international assessments (Pisa, 2006) show the great gap that exists between developing and other countries. This is particularly the case in Peru. More than 12 years have passed since Peru participated for the first time in the Comparative International Assessment organized by UNESCO, along with 13 other Latin American countries. Nearly 54,000 students from the 3<sup>rd</sup> and 4<sup>th</sup> grades were tested in Mathematics and Language skills. The

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results were discouraging for Peruvians, who occupied rank 10 out of 13 in language skills and the last position in mathematics (Unit of Measurement of Educational Quality, 2001). This situation did not change in relatively recent years. In 2006 Peru participated in a Regional Comparative and Explanatory Study (LLECE) in order to evaluate and compare the performance achieved by Latin American students of 3<sup>rd</sup> and 6<sup>th</sup> grade in the areas of Language, Mathematics and Natural Sciences. Peru ranks with scores below the average together with other countries like El Salvador, Ecuador and Dominican Republic (Regional Office for Education of UNESCO, 2008).

The evaluation only seems to have resulted in catastrophic headlines of newspapers (Cue-to, 2007) but did not lead to a careful analysis of the potential and difficulties of Peruvian 6<sup>th</sup> grade students and related variables. It is however for several reasons important to study academic achievement in this group of students. On one hand, little research has been based on this age group: studies regarding this topic were done mainly for 3- or 4-year old children (Jordan, 2007), 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> graders (Bull, 2008; Mullis, 1997), and in high school students (Breslau, 2009). On the other hand, this group is worth to investigate because the children are going through a transitional period (a) from an academic point of view, that is the end of primary school and the beginning of high school and, (b) from a hormonal point of view, the beginning of puberty, accompanied by significant physical and emotional changes (Cavanagh, 2007).

Taking all this elements into consideration, it is our intention to study the academic achievement in 6<sup>th</sup> grade students in public schools versus students in private schools.

### **PERUVIAN EDUCATIONAL SYSTEM AT A GLANCE**

The latest Peruvian Census of 2007 showed that rates of illiteracy in the country fell from 12.8% to 7.1%, which means a reduction of 5.7% in comparison to the levels recorded in 1993. The numbers indicate that

the largest reduction in illiteracy was achieved among women, who in 2003 recorded 18.3%, but now only 10.6%, representing a decrease of 7.7% (INEI, 2008). This development does not last that longer when we have to face another reality. According to reports of the National Mobilization for Literacy (PRONAM) of the Ministry of Education (2008) since 1940 the number of illiterates in the country is almost the same: 2.500.000. Amidst of rapid population growth, statistics say that, in percentage, illiteracy has decreased, but in absolute numbers it has not changed substantially in six decades. To have a better understanding about the educational system we will describe its curriculum design and the hierarchical structure of its institutions.

### THE CONTENT OF THE PERUVIAN EDUCATIONAL SYSTEM

The National Curriculum Design is based on making explicit what, for what and how to teach and learn. It proposes which skills are to be taught throughout each of the cycles (from kindergarten to secondary education), which are achieved in a continuous process through the development of skills, knowledge, attitudes and values articulated properly (Ministry of Education, 2008).

The National Curriculum Design is organized in areas that are complementary in order to ensure comprehensive education, from the initial up to high school level. The areas of the curriculum at primary levels are composed by the following courses: Mathematics, Integral Communication, Environment and Sciences, Social Sciences, Art, Religion, and Physical Education. In this paper we will restrict our focus to Integral Communication and Mathematics.

### INTEGRAL COMMUNICATION

Integral communication area constitutes the pivotal core of the development of the other learning areas. Curriculum development of

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this area is supported by the communicative and textual approach; the former refers to what is considered the main function of language: communication, exchange knowledge, share ideas and experiences, but also addresses the grammar and spelling. The latter represents the textual approach, working with words, sentences or fragments, with the aim of strengthening textual comprehension or production.

### **MATHEMATICS**

The skills for each grade involve the transverse process of reasoning, and problem solving. It refers to the knowledge of numbers, the numbering system which implies the ability to break down natural numbers, use certain forms of representation and understand the meanings of operations and algorithms. It also involves establishing relationships between numbers and operations to solve problems.

### **THE STRUCTURE OF THE PERUVIAN EDUCATIONAL SYSTEM**

According to the Peruvian Constitution education is obligatory and free in public schools for initial levels, primary and secondary. It is also free in public universities, for low-income students having a satisfactory academic performance (Peruvian Constitution, 1993). It is divided into hierarchical and decentralized institutions (see Figure 1). Education in Peru is under the jurisdiction of the Ministry of Education. It is responsible for defining, directing, regulating and managing the national education policy, taking into account the general interests of the state and the diversity of regional realities, in agreement with the unitary and decentralized government of the republic.

The body that monitors the Ministry of Education is the Regional Direction for Education (DRE) and its functions are to plan, implement and manage policies and regional plans in coordination with the Local Education Management Units (UGEL), authorize

and supervise the functioning of public and private institutions. Then we find that the Local Education Management Unit (UGEL) is an instance of the regional government, with autonomy. Its territorial jurisdiction is the province, which can be modified by social dynamics, geographic affinity, economic and cultural or communication facilities. Metropolitan Lima has seven UGEL; Lima and Callao provinces have 10 UGEL and nationally there are 188 UGEL. Additionally, another important function of the UGEL is to formulate, implement and evaluate the budget in response to the needs of schools and educational programs and manage their funding locally, regionally and nationally. It determines infrastructural needs and equipment, and participates in its construction and maintenance as well, in coordination with and support of local and regional governments, and ultimately promotes cultural centers, libraries, theaters and art workshops as well as sports and recreation.

Finally, the educational institution or school as a learning community is the first and main instance of the decentralized education management system. There the provision of service takes place, which may be public or private. It is aimed at achieving learning and comprehensive training of its students. But there are many variations in the type of schools, depending on the state or private network they are part of. Although subject to national standards and a common curriculum, the private school has significant freedom. In the private network (representing 15% of students) are the best schools in the country, some of them providing education linked to other countries (U.S., Great Britain, Italy, Germany, China, etc.) and others ran by religious congregations. Within the public system (85% of students) there are also many variations. In the 50's the well known Great School was established. These were enormous public schools that were able to meet the educational needs of the school population, encompassing facilities, technical equipment, laboratories, offices and equipment. They were very prestigious and highly qualified, but plunged into crisis since the '80s. Currently, the most suc-



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Successful state schools operate in urban suburbs. Despite many difficulties, many of them took interesting innovative efforts. To the contrary, the rural schools, in almost every state, are generally characterized by poor quality (Alcazar, 2009).

Based on this framework we are interested in analyzing and studying the two major school types (private and public) that characterize mostly Peruvian schools. Therefore, the present article wants to answer the following research questions:

How is academic achievement (reading, arithmetic and spelling) in children on 6<sup>th</sup> grade related to child (intelligence, gender, SES) and school (private vs. public) variables?

## METHOD

### SAMPLING METHODOLOGY

Subjects were pupils, recruited via randomly selected elementary schools. We stratified the sample by Local Educational Management Unit (UGEL) in Metropolitan Lima (UGEL 01 - San Juan de Miraflores; UGEL 02 - Rimac; UGEL 03 - Lima; UGEL 04 - Comas; UGEL 05 - San Juan de Lurigancho; UGEL 06 - Ate Vitarte and UGEL 07 - San Borja), school type (public and private) and grade (sixth years of elementary school). In order to do so, we used the statistical data of the Ministry of Education published on their website (<http://www.minedu.gob.pe/>).

### PARTICIPANTS

Overall, the study encompassed 1.160 regular school children attending sixth grade, ranging from 9.57 to 16 years old ( $M = 11.6$ ;  $SD = .62$ ). The majority of subjects were female ( $n = 616$ ; 53.1%) and were in public schools ( $n = 700$ ; 60.3%). Prior to data analysis, we looked at the data for possible outliers. As the aim of our study was academic achievement of 6<sup>th</sup> graders, we looked first for outliers concerning age in order to avoid data error. As a consequence 31 pupils were excluded because the age was outside the range

between 10.5 years and 13.5 years. Table 1 shows the outlier main characteristics: 17 boys (54.8%) and 14 girls (45.2%) whose age ranged between 9.57 and 10.1 or 13.55 and 16 years were left out of the analyses. The vast majority belonged to public schools ( $n = 27$ , 87.1%) and only 4 cases were reported from private schools; 14 cases showed previous school failure in 6<sup>th</sup> grade.

In this sense, the final sample used in this study included 1.129 elementary school children (6<sup>th</sup> grade) over 45 classes in 17 schools from Metropolitan Lima. Of these 527 were boys (46.7%) and 602 (53.3%) were girls. Their mean age was 11.55 years ( $SD = .45$ ), and the ages ranged from 10.57 to 13.3 years. From the total sample 456 (40.4%) participants were from private schools and 673 (59.6%) were from public schools.

Despite having included 7 public and 10 private schools, the number of participants is higher in the public schools. In these schools it is common to find more than three classrooms within the same grade with a high population (more than 40 pupils per classroom) whereas in private schools the majority of classrooms do not exceed 30 pupils (see Table 2).

The mean age in public schools was 11.57 ( $SD = .48$ ). The age for public schools pupils enrolled in the 6<sup>th</sup> grade ranged from 10.5 to 13.3 years. Most participants were female ( $n = 400$ ). With regard to the private sector, the mean age was 11.52 ( $SD = .38$ ) and the age ranged from 10.57 to 12.50 years. In contrast with the public schools, the vast majority of pupils was male ( $n = 254$ ). The frequency of school failure is considerably less than in the public schools. Additionally, there are more single-sex schools among private schools (Pr1 and Pr5 are schools for boys and Pr2 is a school for girls). Table 3 shows the proportion of the sample study compared to the whole population in Metropolitan Lima.

### INSTRUMENTS

Participants were tested in two sessions of 45 minutes each; all tests were administered collectively with exception of the reading

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section that was evaluated individually taking the pupil to a separate room.

The tasks were administered in a fixed order; in the first session Arithmetic and Spelling were assessed with a 10 minute break between testing and in the second session intelligence and reading were administered following the same procedure.

#### READING

In the Reading Section we used Word and Pseudo-word Reading, a subtest of PROLEC-SE Test. This instrument was developed and standardized by Cuetos and Ramos (1999) and consists of a group of scales that essentially evaluate not only the global reading capacity but also other processes and strategies that intervene in the reading task. The Word and Pseudo-word Reading subtests assess visual word recognition (whether the reader recognizes written words correctly and effortlessly). Some studies have documented the word recognition difficulty as one of the major academic skill deficits in children (Landerl, 2001; Shaywitz, 2004). Taking into consideration that it is a necessary pre-requisite for comprehension, the ability to read words fluently and accurately has been one of the most commonly selected topics in research on reading problems (Fletcher, Lyons, Fuchs, & Barnes, 2007).

In the first task the child was asked to read a list of 40 words that contains two, three, four, and five syllables as accurately and quickly as possible. Speed and accuracy are taken into account, by measuring the time it takes for the student to read the full list and verifying the correctness of each word read. The second task was exactly the same but this time the pupil had to read a list of 40 pseudo-words. A global Reading Score emerged from the addition of the two sub-scores. Total scores ranged from 28.36 to 247.50 correct words per minute ( $M = 95.86$ ,  $SD = 26.84$ ).

#### MATHEMATICS

In the area of Arithmetic the Number Facility subtest of the Ekstrom, French, and

Harman (1979) battery was used. We measured speed and accuracy in the four types of basic arithmetic operations: addition, division, subtraction, and multiplication.

In the first task the pupil was asked to solve as quickly and as accurately as possible addition operations in two minutes. All tasks contained two parts with 60 items in each. In the first part, a grid of 60 additions was presented. Each addition was written vertically and consisted of three addends between 1 and 99.

The second task was presented similarly to the first (in a grid of six rows by 10 columns) but in this case the operation was a division written horizontally with a space for the result given underneath each division. The dividend is a number between 10 and 999, and the divisor is a number from 1 to 9.

The third task was presented as a grid of alternating rows of 10 subtractions and 10 multiplications in a total of 60 operations written vertically. Subtractions were made between two digit numbers with the minuend always larger than the subtrahend. Multiplications were made between a two digit and a one digit number. The general and specific instructions of the original instrument were in English, therefore the adequate translation was made from English to Spanish, and then from Spanish to English (back translation). A global Arithmetic Score emerged from the addition of the three sub-scores (Addition, Division and Multiplication, and Subtraction). Global scores ranged from 3 to 215 correct answers in 12 minutes ( $M = 62.49$ ,  $SD = 28.25$ ).

#### SPELLING

According to Berninger (2004) phonological and orthographic processes predict spelling skills. The same author pointed out an important component of transcription within the writing field involving the production of letters and spelling, a process needed to turn ideas into a written product.

In our study the Spelling Achievement Test was used to measure spelling (Dioses, 2001), which assesses three separate aspects of gen-

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eral orthography: (a) literal orthography, referring to the knowledge of the correspondences between phonemes and graphemes, according to spelling rules established by the Royal Academy of Spanish Language; (b) accentual orthography, referring to the correct use of the orthographic accents, according to the standards set by the Royal Spanish Academy of Language spelling, and (c) punctual orthography, the correct use of punctuation and intonation.

In the first task the pupil was asked to write on the answer sheet 11 words dictated by the evaluator. In the second task the evaluator not only dictated words but little sentences as well. Twelve items in total were evaluated. The third and last part consisted of four tasks: the first two were related to locate accurately some punctuation signs, in the first case the correct use of comma (,) and in the second place the correct use of colon (:); two sentences were presented in each part. In the third task the child was asked to write two sentences that were dictated by the evaluator. This task assesses the correct use of question marks (?) so it's very important to interpret the correct intonation of the instructor. Finally in the fourth task the student was asked to locate accurately exclamations mark (!) within two sentences. Scores ranged from 1 to 31 correct answers ( $M = 19.31$ ;  $SD = 5.99$ ).

### *SOCIOECONOMIC STATUS (SES)*

The SES is usually related to the family. However, in our study we came across limitations in the data collection: out of 1129 families, only 586 shared their income information. In order to overcome this limitation we look for an approximation based on complete available data. We found it in the SES of the neighborhood of the school.

The SES scale adopted for schools was the one defined by means of the Peruvian Census Information (2007) that took place in Metropolitan Lima (INEI, 2009). According to this methodology, household incomes are summed across neighborhoods, throughout each district. Household income per capita is ca-

tegorized as: low (380.00 Soles or less); medium - low (380.01 to 550.00 Soles); medium (550.01 to 900.00 Soles); medium-high (900.01 to 1700.00 Soles) and high (more than 1700.00 Soles). In the schools selected for the present study none belongs to the medium - high category. In addition, this SES measure was used as a continuous variable for the analyses.

### *INTELLIGENCE*

Raven's Standard Progressive Matrices (Raven, J., Raven, J.C., & Court, 2004) was used in order to measure intelligence. This test has originally been constructed to measure individuals' so-called analytic or fluid intelligence (Raven, 1960). Fluid intelligence refers to one's capacity to analyze logical relationships and adapt his or her thinking to new cognitive problems (Carpenter, Just, & Shell, 1990; Garlick, 2002). This form of intelligence has often been contrasted to its crystallized counterpart, which refers to knowledge and skills that have been acquired through education and experience (Cattell, 1963). The Standard Progressive Matrices test (SPM) is seen by many as one of the most reliable instruments for assessing the fluid aspects of general intelligence (Sternberg, Grigorenko, & Bundy, 2001). The test consisted of 60 problems divided into five different sets. We transformed the raw scores into Z-scores per age group of six months from our own sample.

### *PROCEDURE*

Data collection was performed as part of a larger study that explores the relationships between parenting, academic achievement and psychosocial functioning of children in Lima. Private and public schools were recruited by phone. A written notification was sent to parents of students in order to give their consent for the participation of their children and themselves in the study. Students were tested in the months from June to



September 2009. The tests were conducted during regular school hours.

#### STATISTICAL ANALYSIS

In order to respect the hierarchical structure of our data, we used multilevel analyses to examine the impact of the different child (IQ, gender, SES) and school variables (school type) on reading, arithmetic and spelling academic achievement.

#### RESULTS

##### FACTOR ANALYSIS

Primarily Principal Component Analysis (PCA) was used to reduce the amount of outcome variables, specifically for Arithmetic (Addition, Division, Subtraction, and Multiplication) and Reading (reading of words and reading of pseudo-words). A PCA was performed on the raw scores of the Arithmetic and Reading tests. Two dimensions emerged: Arithmetic (consisting of the scales Addition, Division, Subtraction, and Multiplication), and Reading (consisting of the scales Reading of words and reading of pseudo-words). Figure 2 shows a plot in which we can see the five variables gathered in two factors. Based on these results the three Arithmetic tests were grouped into one main variable, Arithmetic by adding the different subscores; the same procedure was followed for the two subtests of reading. The percentage of explained variance of the factors and the eigenvalues respectively were as follows: Addition = 54.22%, 2.71; Division = 26.45%, 1.32; Subtraction and Multiplication = 9.02%, .45; Reading of pseudo-word = 5.23%, .26, and Reading of words = 5.07%, .25.

##### MULTILEVEL ANALYSIS

##### SPELLING

In the first part of the analyses the aim was to explore whether it was useful to perform the multilevel modeling in two levels: class and

student. To fulfill this goal intra-class correlation coefficient (ICC) was calculated (Hox, 2002),  $ICC = .298$  which means that 29.8%, the variance is situated at the class level. This percentage indicates that taking the class level into account might be necessary for analyzing spelling achievement.

The second step was entering possible predictors consecutively. In this case we input intelligence, school type, gender and SES as potential predictors. By mean of model comparison and more specifically the deviance information criterion (DIC), non-significant predictors were ruled out of the model (Jones, 2009).

With the first two-level null random intercepts model we intend to look whether the mean academic achievement score of pupils differs between classes, without taking into account differences that can exist between classes and pupils. The intercept-only model estimates the intercept as 19.032, which is simply the average achievement across all classes and pupils. The variance of the pupil level residual errors ( $\delta^2_e$ ) is estimated as 26.15 and the variance of the class level residual error ( $\delta^2_u0$ ) is estimated as 11.14, which means that 29.87% of the variance in spelling achievement is explained by differences between classes (intra-class correlation coefficient of .298) indicating that differences between classes might be substantial. This model is represented as Model 1 as Table 4 shows.

We first included the explanatory variable intelligence. This model is represented as Model 2 in the table. Taking into account intelligence leads to a significant change in the deviance of 546.17 ( $p < .001$ ); the regression coefficient of this variable is significant which means that on average for an increase of one point in intelligence the class increases with 1.78 points in spelling academic achievement. In a following step we used a random intercept, random slope model to check if the effect of intelligence varies across classes; results showed a significant drop of the deviance ( $p < .001$ ). In Model 4 we added school type as a predictor. Taking into account school type leads to a significant change in the deviance of 25.04 ( $p < .001$ ). The regression

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coefficient of this variable is significant which means that on average private schools score 3.75 points higher on spelling achievement than public schools. In Model 5, we use a random intercept, random slope model to check if the effect of school type varies across classes; results showed a significant drop of the deviance ( $p < .05$ ). In a following model we took into account gender leading to a significant change of the deviance 13.76 ( $p < .05$ ), this means that on average girls score 1.72 points higher on spelling achievement than boys. Finally neither a random intercept model in this variable was significant nor SES ( $p > .05$ ). All parameters estimates were much larger than the corresponding standard errors (S.E.) and the calculation of the Z-test demonstrate that they are all significant at  $p < .01$ .

*ARITHMETIC*

The intercept-only model estimates the intercept as 62.39, which is simply the average achievement across all classes and pupils. The variance of the pupil level residual errors ( $\delta^2_e$ ) is estimated as 516.35 and the variance of the class level residual error ( $\delta^2_{u0}$ ) is estimated as 346.67, which means that 40.17% of the variance in arithmetic achievement is explained by differences between classes (intra-class correlation coefficient of .40) indicating that differences between classes might be substantial. This model is represented as Model 1 as Table 5 shows.

We first included the explanatory variable intelligence. This model is represented as Model 2 in the table. Taking into account intelligence leads to a significant change in the deviance of 679.11 ( $p < .001$ ); the regression coefficient of this variable is significant which means that on average for an increase of one point in intelligence the class score increases with 6.16 points in arithmetic achievement. In a following step we used a random intercept, random slope model to check if the effect of intelligence varies across classes; results showed a significant drop of the deviance ( $p < .01$ ). In Model 4 we added school type as a predictor.

Taking into account school type leads to a significant change in the deviance of 8.16 ( $p < .05$ ). The regression coefficient of this variable is significant which means that on average private schools score 10.88 points higher on arithmetic achievement than public schools. In Model 5, we use a random intercept, random slope model to check if the effect of school type varies across classes; results showed a significant drop of the deviance ( $p < .05$ ). In a following model we took into account gender and socioeconomic status, but this did not lead to a significant change in the deviance ( $p > .05$ ).

*READING*

The intercept-only model estimates the intercept as 93.70, which is simply the average achievement across all classes and pupils. The variance of the pupil level residual errors ( $\delta^2_e$ ) is estimated as 552.45 and the variance of the class level residual error ( $\delta^2_{u0}$ ) is estimated as 175.85, which means that 24% of the variance in reading achievement is explained by differences between classes (intra-class correlation coefficient of .24). These preliminary results indicate that differences between classes might be substantial. This model is represented as Model 1 as Table 6 shows.

We first included the explanatory variable intelligence. This model is represented as Model 2 in the table. Taking into account intelligence leads to a significant change in the deviance of 28.982 ( $p < .001$ ); the regression coefficient of this variable is significant which means that on average for an increase of one point in intelligence the class score increases with 4.46 points in reading achievement. In a following step we used a random intercept, random slope model to check if the effect of intelligence varies across classes; results showed a significant drop of the deviance ( $p < .001$ ). In Model 4 we added school type as a predictor. Taking into account school type leads to a significant change in the deviance of 22.66 ( $p < .001$ ). The regression coefficient of this variable is significant which

means that on average private schools score 14.45 points higher reading achievement than public schools. In Model 5, we use a random intercept, random slope model to check if the effect of school type varies across classes; results showed a significant drop of the deviance ( $p < .05$ ). In following models we took into account socioeconomic status and gender, but this did not lead to a significant change in the deviance ( $p > .05$ ).

## DISCUSSION

The main objective of this paper was to examine in detail the impact of a group of variables including child (intelligence, gender and age), contextual (type of school) and distal variables (SES) in Arithmetic, Spelling, and Reading performance of 6<sup>th</sup> grade children in Perú. The greatest impact seen was from the contextual type of school variable, followed by child variables such as intelligence. In addition, the gender of the child was proven to have some influence (in the case of Spelling).

Throughout the manuscript we have seen interesting results that were expected and that support previous studies. We will look at each of these aspects attentively, in order to contribute to a better understanding of achievement predictors in Peruvian primary education.

The most obvious finding was the proportion of students whose age exceeds the normal age range of children in the last year of primary education. Children of 14, 15, and even 16 years old participated in the study, reflecting the evident retention or drop-out rates. These results are strongly correlated with the socioeconomic characteristics of the families these children live in (MacLauchlan, 1994). Children from families with more economic constraints are forced to miss classes or even abandon school temporarily. This macro problem is essentially rural but still found in urban zones (29.4% versus 9% respectively; Alcazar, 2009). This tendency applies to our study: 18 children (1.6%) of the total sample were involved in informal work (cleaning cars in the streets or being in

informal selling) in order to earn money to help with the expenses of the family.

Which are more effective, private or public schools? The two school types in the country are source of endless debate. What we can say is that type of school has shown a great impact in demonstrating in general terms that students who regularly attend private schools obtain higher scores compared to those in public schools. Regarding this point, wide literature continues to show the differences between them and make evident the disadvantages of public schools in the supply side such as infrastructure, classroom equipment and materials, and the demand side including absenteeism, desertion, repetition and as a consequence delay (Anghel & Cabrales, 2010; Larrañaga, 2004; Tobon, Valencia, Rivers, & Bedoya, 2008; Trillo, Pérez, & Marcos, 2007).

In relative terms, it has been reported that the money invested on education for a student in a public school (adding the contribution of the state and families) is less than the one that takes place in private schools. As a result it is possible that differences in the quality of the service provided will be generated (Saavedra & Suarez, 2001).

That intelligence plays a very important role in academic achievement in primary education is reflected in its high levels of significance in all the outcome variables. Substantial research effort has been devoted to prove the association between intelligence and performance in different developmental areas (Deary, Whiteman, Starr, Whalley, & Fox, 2004). Grabner, Neubauer, and Stern (2006) studied the impact of intelligence on cognitive performance. Results demonstrated that brighter participants performed better than the less intelligent.

The expected SES predictor did not reach main effects. The presented results contrast with a great body of evidence suggesting the link of SES and achievement (Hecht & Greenfield, 2001; Opkala, Smith, Jones, & Ellis, 2000). To test the adequacy of the sample a power analysis was performed. Results provided evidence that the number of participants in the study was sufficient to detect moderate differences. This can lead us

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to think that differences may exist but are very subtle. Some studies have documented about the small association between SES and academic performance. In this regard, White (1982) concluded in his meta-analytic research about associations between SES and academic achievement, that correlations are positive but weak, therefore we can only account for less than 5% of the variance in the student performance.

Additionally, findings in previous studies concerning to gender and its relationship specifically with Spelling were corroborated. Studies have reported the prevalence of girls rather than boys in general language ability in this case involving spelling (Bond, Dykstra, Clymer, & Summers, 1997). Although we did not encounter significant effects in Arithmetic, previous research findings favor males in general mathematical achievement over girls (Gallagher & Kaufman, 2005; Persson, 1988).

To summarize, overall results of this study provide evidence for the Peruvian academic achievement in 6<sup>th</sup> grade children. Our main research focus was to analyze student performance in three core areas of primary education: Reading, Arithmetic, and Spelling, which are pivotal courses involving prerequisite skills necessary for later development.

Implications can be addressed regarding the importance of the target sample. Children in sixth grade experience a great amount of changes which seems to indicate that they come across with a critical period: dealing not only with some alterations typical of early adolescence but also with the important transition from primary to secondary school. For this reason 6<sup>th</sup> grade can be considered as a risk population worth to be investigated. In addition, we've seen the great impact that different kind of schools are playing. Major

educational institutions may want to consider some specific policies with the purpose of reducing the inequity in particular prominent in public schools.

The first pedagogical implication is to bring this group to average levels in the areas with deficit. If there are difficulties in the basic areas of learning, these difficulties will only worsen upon the transition from primary to secondary school (Nguyen & Roedder, 2007; Yurgelun-Todd, 2007). These students will lack the requisite skills needed to fulfill in secondary academic expectation. Supporting children in these conditions is important.

Second, for children with normal levels in the studied areas, stimulating the reading skills (consequently orthography) is recommended. Making literary texts matching their tastes available would encourage them to enjoy reading. This would ensure the development of cognitive capabilities that allow them not only to read, but to understand correctly. Nevertheless, this study has some limitations such as the lack of data from rural zones hinders us to make comparisons between rural and urban zones.

Future work is needed to investigate academic performance associated with other variables that might influence the child's development such as parenting behavior or psychosocial factors. We have to recall that primary education is designed to promote the integral development of the students and allow them to display their potential knowledge, attitudes and fundamental values in a model that encompasses multiple factors. In the same way, further investigation needs to be devoted to studying possible learning difficulties in these children and its relationship with other student or contextual factors.

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FIGURE 1  
PERUVIAN HIERARCHICAL EDUCATIONAL SYSTEM

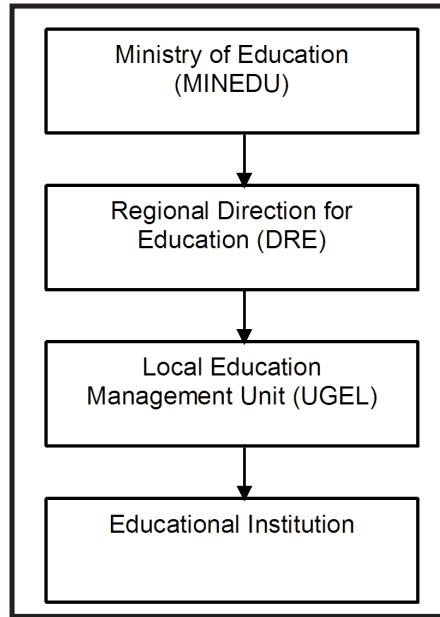
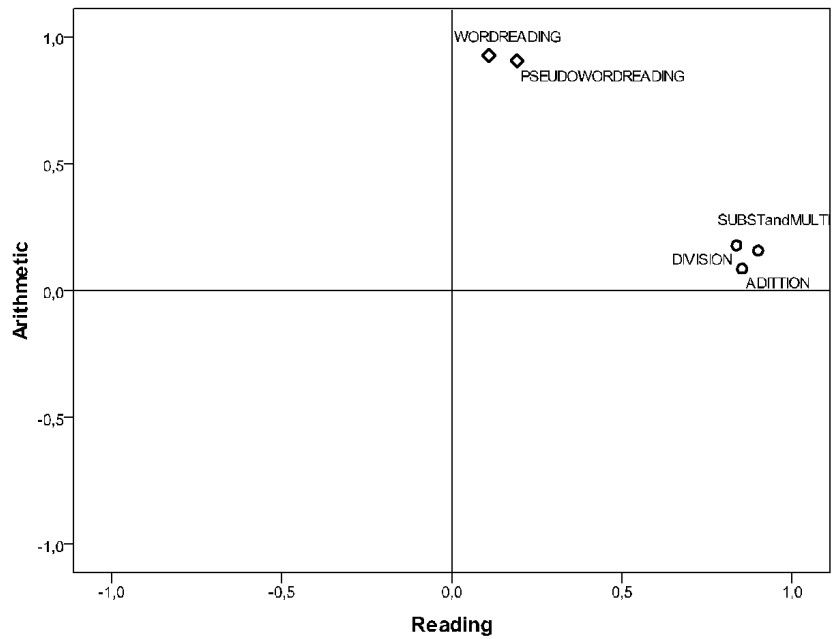


FIGURE 2  
FACTOR PLOT: ARITHMETIC AND READING





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TABLE 1  
 OUTLIERS DIFFERENTIATE BY TWO AGE GROUP: DISTRIBUTION OF AGE, GENDER, TYPE OF SCHOOL AND SCHOOL FAILURE ARE CONSIDERED

Age Group	Age Range	Subjects	Gender		Type of school		School failure in 6 <sup>th</sup> grade
			Male	Female	Public	Private	
Group below 10.5 years Group above 13.5 years	09y7m - 10y1m	4	2	2	1	3	0
	13y7m - 16y0m	27	15	12	26	1	14
Total		31	17	14	27	4	14

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TABLE 2  
AGE, GENDER, SCHOOL FAILURE, AND NUMBER OF CLASSROOM OF STUDENTS IN THE 6<sup>TH</sup> GRADE

School (n = 17)	Classes n	Age		Gender		School Failure n
		M	SD	Male	Female	
<b>Public</b>						
Pu1 (n = 189)	5	11.45	.46	94	95	18
Pu2 (n = 112)	5	11.63	.48	66	46	14
Pu3 (n = 79)	4	11.55	.59	40	39	14
Pu4 (n = 36)	2	11.70	.57	17	19	6
Pu5 (n = 143)	7	11.60	.42	0	143	4
Pu6 (n = 94)	4	11.58	.47	44	50	1
Pu7 (n = 20)	1	11.79	.50	12	8	0
<b>Private</b>						
Pr1 (n = 28)	1	11.58	.36	28	0	0
Pr2 (n = 41)	2	11.50	.30	0	41	0
Pr3 (n = 15)	1	11.41	.49	9	6	0
Pr4 (n = 182)	4	11.48	.35	90	92	4
Pr5 (n = 50)	2	11.87	.29	50	0	3
Pr6 (n = 12)	1	11.83	.24	4	8	2
Pr7 (n = 40)	1	11.50	.37	20	20	0
Pr8 (n = 38)	2	11.42	.35	23	15	2
Pr9 (n = 13)	1	11.37	.37	6	7	1
Pr10 (n = 37)	2	11.32	.37	24	13	0

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TABLE 3  
COMPARISON BETWEEN TOTAL POPULATION IN METROPOLITAN LIMA AND SAMPLE OF CURRENT STUDY

	Pupils		Total	Schools		Total
	Private	Public		Private	Public	
Total Population	95289	50166	145455	3 318	907	4225
Current Study	456	673	1129	10	7	17

TABLE 4  
FIXED AND RANDOM EFFECTS OF ALL SIX MODELS IN SPELLING ACHIEVEMENT

Fixed Effect	Model 1 Null Model		Model 2 Intelligence		Model 3 Intelligence at class level		Model 4 School type		Model 5 School type at class level		Model 6 Gender	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Predictor												
Constant	19.03*	.50	19.40*	.40	19.21*	.45	18.09*	.39	18.01*	.71	18.03*	.32
Intelligence			1.78*	.17	1.74*	.17	1.73*	.21	1.70*	.50	1.69*	.41
School type							3.75*	.60	3.46*	.92	3.45*	.82
Gender											1.72*	.21

(Continúa)

TABLE 4 (CONTINUACIÓN)  
FIXED AND RANDOM EFFECTS OF ALL SIX MODELS IN SPELLING ACHIEVEMENT

	Model 1 Null Model	Model 2 Intelligence	Model 3 Intelligence at class level	Model 4 School type	Model 5 School type at class level	Model 6 Gender
Random Effect	Coef. S.E.	Coef. S.E.	Coef. S.E.	Coef. S.E.	Coef. S.E.	Coef. S.E.
$\delta^2_e$	26.15* 2.31	23.54* 2.02	22.41* 1.90	22.04* 1.52	21.98* 1.26	
$\delta^2_{U0}$	11.14* 2.60	7.52* 2.51	5.79* 1.48	3.06* .89	3.01* 1.20	
$\delta^2_{U1}$			1.78* .52	1.76* .40	1.50* .45	
$\delta^2_{U2}$					3.75* 1.22	
Deviance	6621.86	6075.69	6052.76	6027.72	6015.65	6001.89

Note

- \* Coefficient is significant (i.e.,  $\beta > 1.96*SE$ ).
- $\beta$  is statistical significant at the .05 significance level
- S.E. Standard Error
- $\delta^2_e$  = Variance of the pupil level residual errors
- $\delta^2_{U0}$  = Variance of the class level residual errors
- $\delta^2_{U1}$  = Variance component for the regression coefficient of IQ
- $\delta^2_{U2}$  = Variance component for the regression coefficient school type

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TABLE 5  
FIXED AND RANDOM EFFECTS OF ALL FIVE MODELS IN ARITHMETIC ACHIEVEMENT

	Model 1 Null Model	Model 2 Intelligence	Model 3 Intelligence at class level	Model 4 School type	Model 5 School type at class level
Fixed Effect	Coef. S.E.	Coef. S.E.	Coef. S.E.	Coef. S.E.	Coef. S.E.
Predictor					
Constant	62.39* 2.88	50.02* 2.31	47.10* 1.50	45.25* 2.50	42.34* 2.41
Intelligence	6.16* .81	6.16* .81	6.10* .95	6.05* .50	60.06* .72
School type				10.88* 2.32	10.02* 2.55
Random Effect	Coef. S.E.	Coef. S.E.	Coef. S.E.	Coef. S.E.	Coef. S.E.
$\delta^2_e$	516.35* 22.85	487.63* 22.33	484.67* 22.61	480.52* 22.02	477.85* 22.88
$\delta^2_{U0}$	346.67* 78.51	319.42* 72.93	318.81* 72.96	289.02* 72.45	280.35* 71.99
$\delta^2_{U1}$			6.16* 2.01	6.02* 1.87	6.05* 2.02
$\delta^2_{U2}$					10.88* 3.26
Deviance	9807.95	9128.85	9117.89	9109.73	9100.025

Note

- \* Coefficient is significant (i.e.,  $\beta > 1.96*SE$ )
- $\beta$  is statistical significant at the .05 significance level
- S.E. Standard Error
- $\delta^2_e$  = Variance of the pupil level residual errors
- $\delta^2_{U0}$  = Variance of the class level residual errors
- $\delta^2_{U1}$  = Variance component for the regression coefficient of IQ
- $\delta^2_{U2}$  = Variance component for the regression coefficient school type



TABLE 6  
FIXED AND RANDOM EFFECTS OF ALL FIVE MODELS IN READING ACHIEVEMENT

	Model 1 Null Model		Model 2 Intelligence		Model 3 Intelligence at class level		Model 4 School type		Model 5 School type at class level	
Fixed Effec	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Predictor										
Constant	93.70*	2.13	89.61*	2.03	88.01*	2.21	85.72*	2.04	83.25*	2.33
Intelligence			4.46*	.82	3.82*	.90	3.05*	.72	2.97*	.96
School type							14.45*	3.59	13.89*	2.33
Random Effec	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
$\delta^2_e$	552.45*	4.31					532.6*	30.21	531.22*	32.40
$\delta^2_{U0}$	175.85*	22.63	537.05*	32.01	538.32*	25.60	132.78*	26.58	127.31*	23.08
$\delta^2_{U1}$			158.34*	25.32	147.23*	23.02	14.20*	2.85	15.98*	4.50
$\delta^2_{U2}$					15.23*	3.21			20.35*	5.42
Deviance		9509.93		9480.95		9462.71		9440.05		9428.68

Note

- \* Coefficient is significant (i.e.,  $\beta > 1.96*SE$ )
- $\beta$  is statistical significant at the .05 significance level
- S.E. Standard Error
- $\delta^2_e$  = Variance of the pupil level residual errors
- $\delta^2_{U0}$  = Variance of the class level residual errors
- $\delta^2_{U1}$  = Variance component for the regression coefficient of IQ
- $\delta^2_{U2}$  = Variance component for the regression coefficient school type

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