Risk Factors for Low Academic Performance and Social Inequality in Peru according to PISA 2012

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Abstract

This study applies a multilevel logistic model to the results obtained by Peruvian students in the PISA2012 survey and analyzes the factors associated with risk for low academic performance in level 2 competencies, using as a baseline mathematics, reading, and science skills tests.

The students' socio-economic background and the social composition of their schools stand out as the factors that most affect at-risk students. Parental occupation, family structure, attendance in pre-primary education, grade repetition, the student's native language, and delay in schooling are factors that affect the probability of risk. At the school level, it is noteworthy that traditional factors such as school size, urban/rural location, and public/private management were not found to be significant.

Keywords: Peru; PISA; economics of education; social inequality; students at-risk; student achievement.

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Siglas y abreviaturas usadas

BIE	Bilingual intercultural education (Educación intercultural bilingüe)
BRR	Balanced repeated replication method
CEBA	Alternative Basic Education Center (Centro de Educación Básica Alternativa)
CULTPOSS	Cultural possessions
ESCS	Economic, social, and cultural status of students
HEDRES	Home educational resources
HISEI	Highest Parents' Socio-economic Index
HOMEPOS	Index of home possessions
HWI	Household wealth index
IDB	Inter-American Development Bank
INIDE	National Institute of Educational Research and Development (Instituto Nacional de Investigación y Desarrollo Educativo)
IRT	Item response theory
ISCO	International Standard Classification of Occupations
LEADCOME	Framing the school's goals and curricular development
LEADINST	Instructional leadership
LEADPD	Promoting instructional leadership and professional development
LEADTCH	Teacher participation in leadership
MINEDU	Ministry of Education, Peru
NCES	National Center for Education Statistics, United States
OECD	Organization for Economic Co-operation and Development
PISA	Program for International Student Assessment
SCMATBUI	Quality of school's physical infrastructure
SCMATEDU	Quality of school's educational resources
TERCE	UNESCO Second Comparative and Explanatory Regional Study (Segundo Estudio Regional Comparativo y Explicativo de Unesco)
SCHAUTON	School autonomy
STUDCLIM	Student-related factors affecting school climate
TCFOCST	Teacher focus
TCHPARTI	Teacher participation and autonomy
TCMORALE	Teacher morale
TCSHORT	Teacher shortage

TEACLIM	Teacher-related factors affecting school climate
TERCE	UNESCO Third Comparative and Explanatory Regional Study (Tercer Estudio Regional Comparativo y Explicativo de Unesco)
UMC	Learning Quality Measurement Office (Oficina de Medición de la Calidad de los Aprendizajes)
UNESCO	United Nations Educational, Scientific and Cultural Organization
VIF	Variance inflation factor

INTRODUCTION

The Program for International Student Assessment (PISA) measures, in cycles of three years, the capacity of students to utilize the skills and knowledge they have developed in the areas of mathematics, reading, and the sciences in order to tackle the situations and challenges posed to them by today's society and to participate fully in it. Its common comparative international framework generates empirical data of relevance to the formulation and discussion of education policy.[1]

The PISA tests measure a set of tasks to be undertaken for each competency and identify blocks that enable the classification of performance levels, each of which have a special meaning associated with the tasks that a student can perform. These levels are also broken down into subscales, or domains. Six or seven performance levels are determined for each area assessed (see Annex 1 for more details).

This study focuses on the Peruvian students who took the tests. To this end, it uses the database containing the results obtained in three competency tests, as well as information from the contextual questionnaires completed by students and principals at the participating schools. The objective is to explore the school-related and social factors associated with performance - and especially with low-performing students. The latter are defined as those with learning achievements below competency Level 2, which constitutes the baseline across all competency tests.

Indeed, PISA 2012 regards Level 2 as the baseline and the minimum level of proficiency required to participate fully in modern society and benefit from better opportunities in the job market (OECD 2013a: 68). This classification has been valid since 2007, when an international group of experts involved in the program, following a detailed analysis of the questions that guided the testing framework, identified this level as that denoting basic aptitude (OECD 2007: 44). This assumption, which can be debated, has been accepted by the scientific community in many of the reports that use PISA data and is also adopted in this study.

In this study, those students below Level 2 are considered to be at academic risk, setting them apart from those whose achievements exceed this level, who are deemed students not at risk. These two categories constitute our focal-point.

1. Given this conception, the PISA results do not directly measure the attainment of curriculum objectives established in each country's teaching programs. In the case of Peru, part of this role is assumed by the census assessments conducted by the Learning Quality Measurement Office (Oficina de Medición de la Calidad de Aprendizajes, UMC) of the Ministry of Education (MINEDU).

The concept of academic risk is not a new one, having emerged almost three decades ago in a national-level report published in the Unites States that explored the idea of failure (NCES 1992)[2]; the report addressed both the likelihood of dropping out of school and student performance levels below the baseline previously established for this country.

More recently, this notion was applied to PISA data but without consideration of dropping out. For example, Choi *et al.* (2013: 570), when explaining the determinants of academic failure in Spain based on PISA 2009 data, define risk as the probability of a student having a performance level below Level 2 in the competencies measured. Meanwhile, Guio and Choi (2014) use this definition to study the evolution of the factors that have a significant influence on school risk in the PISA rounds of 2000, 2003, 2006, and 2009. It is interesting to note that these studies, just as their NCES predecessor, apply a multi-level logistical regression model due to the nested hierarchal structure of the data used (student belonging to a school) and the dichotomous character of the variable of interest (risk/no risk).

GENERAL OVERVIEW OF THE RESULTS OF THE 2012 PISA TEST

The results of the PISA 2012 test have been widely disseminated both within Peru and internationally. In general, these point to a rather unflattering school performance situation in Peru and in the other Latin American participants (Argentina, Brazil, Chile, Colombia, Costa Rica, and Mexico). Indeed, these countries are located in the lowest third of the score distribution for mathematics, the main focus of this round, among the 65 participating countries and territories (OECD 2013a). The database, as well as an extensive literature of reports and bulletins concerning the official results, are available on the PISA website.[3] Moreover, the comparative presentations dedicated to Latin American countries can be consulted in the Inter-American Development Bank's collection of bulletins about education.[4]

In the case of Peru, the progress made between 2001 (the year in which the country first participated in PISA) and 2012 is notable: the percentages of students at the lowest levels decreased dramatically - from 80% to 60%. But between 2009 and 2012, which are comparable due to Peru's participation in both of these rounds, there was no improvement in either mathematics or the sciences. Meanwhile, at the other extreme of the distribution

2. The national Education Longitudinal Study project of 1988, sponsored by the National Center for Education Statistics (NCES) of the United States.
3. <www.oecd.org/pisa>.
4. <blogs.iadb.org/educacion>.

of results, the national report (MINEDU 2013: anexo 1) reports the proportion of pupils who attained Level 6, the highest for the three competencies measured, as non-existent, and between 0% and 0.5% in the case of those who achieved the preceding Level 5.[5] It has also been found that students at private schools exhibit the same behavior as their private counterparts when their socioeconomic levels are comparable (MINEDU 2015: 5).[6]

As to the associated factors, it is necessary to go back to PISA 2000+ (MINEDU 2004) to obtain information about them and about the area of reading. The report states that parental education level, parental occupation, and the possession of educational resources at home are the most important factors in explaining performance differences. Other favorable factors are advanced levels of schooling, and participation in and sense of belonging to the school. With respect to the schools, social composition is highly relevant in the case of those attended by students from advantaged socioeconomic backgrounds; this would seem to be the institutional factor that contributes the most to explaining differences in performance.

Moreover, the report attributes 58% of the difference in results to the characteristics of the schools, and 42% to those of the students. With the usual disclaimers and strictly by way of reference, the calculations employed in PISA 2012 place these percentages at 48.9% and 51.1%, respectively, also for the area of reading, with a significant reduction in the influence of the school - the reasons for which remain to be explained.

Although the student population assessed (elementary school) is not comparable with that of PISA, it should be mentioned that the first results of TERCE (2014)[7] for Peru report that, on a progressive scale from 1 to 4 levels at the end of elementary school, 26% of students obtained results below Level 2 in mathematics, 22% in reading, and 38% in sciences by the end of elementary school. However, there do appear to have been improvements from the previous test, the UNESCO Second Comparative and Explanatory Regional Study (Segundo Estudio Regional Comparativo y Explicativo de Unesco, SERCE) conducted in 2006, with increases in the percentage of students attaining intermediate and high levels in the competencies assessed.

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5. More specifically, 0.5% (standard error: 0.2) in mathematics and in reading (standard error: 0.1) and 0% in the sciences.
6. The afore-mentioned report (MINEDU 2013) covers both the results of PISA 2012 and those of the UNESCO Third Comparative and Explanatory Regional Study (Tercer Estudio Regional Comparativo y Explicativo, TERCE).
7. Following on from the SERCE, UNESCO conducted the TERCE in 2013 in 15 Latin American countries, as well as the state of Nuevo Léon in Mexico.

Ultimately, the official report (MINEDU 2013: 76) observes that the results of PISA 2012 speaks of an educational system that does not assure the vast majority of students sufficient academic attainment across the three competencies assessed, and that academic excellence is practically non-existent. In addition - as with the national assessments and other studies conducted since 1996 - the authors call for more action and commitment from parents, teachers, principals, and government bodies in implementing genuinely effective policies. To address the situation regarding the two categories of students considered in this study, it is worth illustrating the distribution of results from the tests of the three competencies assessed (see Table 1).

Table 1
Students at risk and not at risk by competencies in Peru – PISA 2012 (in averages, differences of averages and percentages; standard error in parentheses)

	Mathematics	Reading	Sciences
Overall average of students	368.1 (3.66)	384.2 (4.34)	373.1 (3.58)
Average higher than Level 2	330.7 / 477,4 (1.84 / 3.11)	323.4 / 474.4 (2.09 / 3.10)	331.9 / 461.2 (1.91) (2.73)
Differences of averages	- 146.7[1] (3.72)	- 151.0[1] (3.69)	- 129.3[1] (3.11)
Percentage higher than Level 2	74.6 / 25.4 (1.75)	59.7 / 40.3 (1.95)	68.2 / 31.8 (1.97)

Note
[1] Significant difference values $\rho < 0.001$.
Source: PISA (2012) database; compiled by the author.

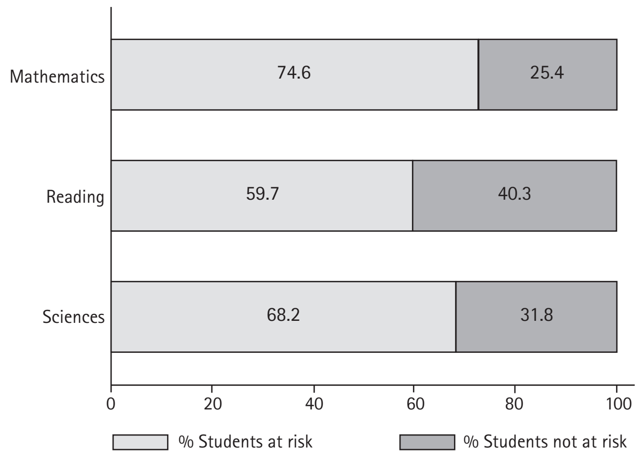
At the international level, it should be recalled that the scores have been aligned to an average value of 500 points for all PISA participants. In Peru, the lowest score attained corresponds to mathematics, at 368 points, and the highest to reading, at 384 points. At any rate, these values are distant from the international average, which at the same time reflects differences between the three disciplines.

The division into levels below or equal to Level 2 and greater than Level 3 allows the average scores for each group of students, and, above all, the differences in scores between groups, to be obtained. The extent of the differences in scores between the two categories of students is striking. In reading, the difference reaches a maximum of 151 points, equivalent to 46.6%.[8]

The percentages enable a reading of the differences in proportions. They provide evidence to show that greater or lesser risk is dependent on the discipline. The proportions highlight the area of mathematics as the discipline with the greatest proportion of students at risk, at 74.6%. The least affected area, in relative terms, is reading, at 59.7%.

These percentages are provided in Graph 1. An already modest overall performance is compounded by pronounced academic inequality between students. To aid comparison and as a point of reference, annexes 2 and 3 present the percentages and averages of students at risk and not at risk, as well as their respective standard errors, as per the set of characteristics to be used hereinafter.

Graph 1
Students at risk and not at risk according to competency Level 2 in Peru – PISA 2012 (in percentages)

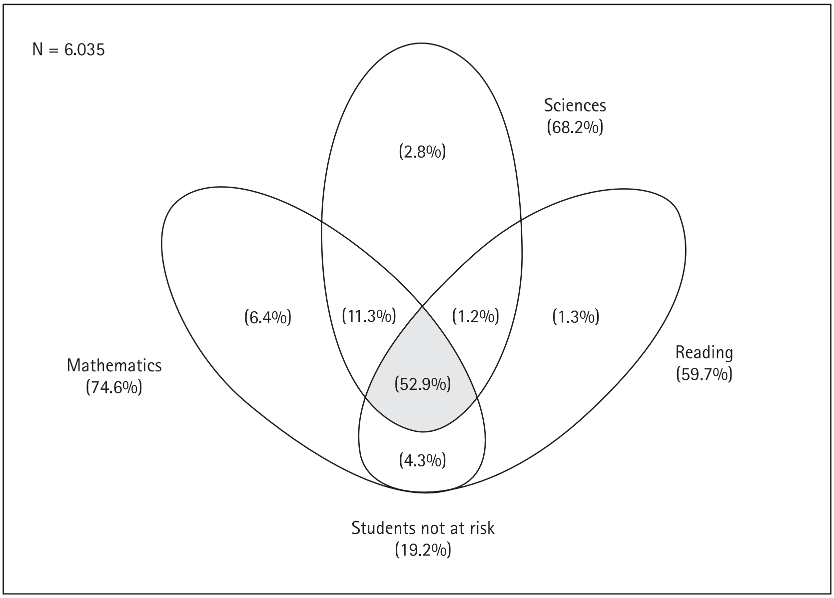


Note
The standard errors are: mathematics, 1.75; reading, 1.95; sciences, 1.97.
Source: PISA (2012) database; compiled by the author.

8. PISA suggests reading these differences on a scale with values that are the equivalent to one year of schooling, based on a multi-level model devised by the body. The equivalents are: 41 points for mathematics, 39 points for reading, and 38 points for sciences (OECD 2013a: 46), so that, for example, 151 points of difference in reading would be equivalent to 3.8 years of schooling.

To be sure, since academic risk is not limited solely to a single competency, it is possible to find students with low performance in one competency but not in (an)other(s). One way of considering this possibility is to consider the three student competencies simultaneously, combining the results in percentage terms with the aid of the Venn diagram shown in Graph 2. There, the students are distributed in groups according to whether they are at risk in a single competency, in two, or in three simultaneously. The diagram shows portions that are not proportional to the size of each possible combination, but the figures clearly show the extent of each.

Graph 2
Overlap of students at risk and not at risk as per competency Level 2 in Peru-PISA 2012 (in percentages)



Source: PISA (2012) database; compiled by the author.

The percentage of low-performing students in each of the competencies is shown at the areas of intersection of the three ellipses. Thus, there are 6.4% students with low performance levels in mathematics alone, 1.3% in reading alone, and 2.8% in the sciences alone. Moreover, there are 4.3% with low performance levels in mathematics and reading, 11.3% in mathematics and sciences, and 1.2% in reading and sciences. Finally, across the three competencies, 52.9% of students are simultaneously located at low performance levels. Thus, more than half of Peruvian students are at academic risk according to the three competencies measured by PISA.

The figure also shows a value that is worth noting: beyond the ellipses, the modest presence of 19.2% of students not at risk - situated above the baseline when the three competencies are regarded as a whole - provides some grounds for optimism; while this figure falls short of being satisfactory, it shows that there are potential capacities to be developed.

Although these are the results of an international test that does not measure curriculum and only measures some of the competencies taught in schools, the total of 53% of students with low performance levels undoubtedly constitutes an enormous challenge to be confronted. As an aside, although it can be assumed that education is a long-term process, the effectiveness of certain educational policies implemented over time is reflected in these results in one way or another, and these can be assessed in order to propose solutions.

DATA AND METHODS

The PISA 2012 data sample in Peru included a selection of state and non-state as well as urban and rural educational institutions nationwide, and a selection of students from each. The data collection stage took place during the last week of August and the first week of September 2012. The target population was comprised of 15-year-old students enrolled in a secondary school or equivalent (alternative basic education centers [Centros de Educación Básica Alternativa, CEBA]) educational institution, who were in grade 7 or above and in the age range of 15 years and three months and 16 years and two months at the time of the study.

The sample assessed was made up of 6,035 students in 240 schools. The instruments applied included 13 booklets with items related to reading, mathematics, and sciences randomly assigned to each student. Each booklet contained between 50 and 55 items. It should be noted that PISA is not a curriculum examination, in that the competencies it assesses have been selected by a group of experts based on international trends and studies about the types of skills that are expected to be required in the future. As such, the test is not designed to estimate the extent to which specific curriculum plans are being fulfilled (MINEDU 2013).

It is also necessary to point out that the national report recommends taking into account the progress made by the educational system in recent years in expanding coverage and reducing the number of students below grade level. This would entail the inclusion of a larger proportion of the overall population of 15-year-olds enrolled in the school system, as well as a lower average age of students who take the PISA test (within the age range established as a target).

As is now customary, the database assigns each student five plausible values that represent the score obtained in each of the three tests of the competencies assessed. These values are a representation of the range of competencies that each student can be assumed to possess within reasonable limits. Therefore, rather than directly estimating a single score, these plausible values are the random estimation of the distribution of each score obtained. For this reason, the database records each student with five plausible values for mathematics, five for sciences, and five for reading. All calculations concerning the scores must take into account these values simultaneously.

Moreover, since each student pertains to a given scale, the structure that is formed necessitates the use of so-called linear hierarchal models, or multi-level models. These apply to clustered data on clustered student data, such as schools. Blanco-Blanco et al. (2014) warn that many studies based on PISA data continue to primarily and erroneously employ multiple linear regression at a single sample level, thereby overlooking the nested structure of the data.

Because PISA uses a sample design and the application of statistical distribution formulas for simple random sampling is therefore biased, and so as not to underestimate the variances, these are estimated with the aid of replication methods that function by generating various subsamples or samples that repeat the original sample. The balanced repeated replication (BRR) method is used.[9]

To address the situation of at-risk students, it was necessary to construct values that enable the classification of students according to whether or not they belong to either of the two categories defined. Therefore, based on each plausible value that represents the score obtained by these students in each of the three tests, a binary variable corresponding to each of these plausible values was constructed. To this end, each one of them was dichotomized according to the conventional cut-off point that demarcates the boundary between scores above and below Level 2 for each of the three competencies. The pre-established values have been set at PISA 2012, namely: mathematics, 420.1; reading, 407.5; sciences, 409.5 points.

9. Moreover, to correct any deviation that may occur in some cases due to a reduced number of observations, the PISA reports apply Fay's correction, whose value is 0.5.

Thus, five binary dichotomous values are obtained, coded with a value of 0 for those scores higher than Level 2 (not at risk) and 1 for those below Level 2 (at risk); hence, in mathematics, for example, a student, as well as possessing five variable values, also has five binary variables (with values of 0 and 1 according to whether they belong to the at-risk or not-at-risk category). These binary variables become the dependent variables in a logistic model. The PISA data analysis manuals complement the practical methods in obtaining these values (OECD 2009).[10]

The binary character of the dependent variable entails the use of multilevel logistic regression for its analysis, which is preferred to the probit model because it produces coefficients that can be interpreted as odds ratios. In addition, both models produce similar, albeit not identical, inferences. The option of preference depends to a large extent on the disciplinary area in which each model is used. Thus, in econometrics, probit can be said to be the default option, with heteroscedastic econometric models in particular; while in education, logistic models are frequently employed for categorical variables. An extensive presentation and discussion of these two methods can be found in Greene (2011).

As regards the selection of the factors that comprise the set of independent variables that determine academic risk, a set of predictors has been selected based on the objectives of this study, the theoretical references corresponding to current research in the area, and the availability of responses to the contextual questionnaires.

Aside from the scores (plausible values), the database provides a miscellany of indexes constructed by PISA based on the responses recorded in the questionnaires applied. In this regard, two types of indices can be distinguished:

- Simple indices, which are constructed by way of arithmetical transformation or recoding of one or more items; and
- Scale indices, which are constructed through scaling of the dichotomous items in estimates of the latent variables, after application of the item response theory (IRT) or the Likert items taken from those responses with more than two categories in the questionnaires.

The PISA 2012 technical report (OECD 2014a: 306-346) extensively discusses the procedure and the validation of the constructs based on the questionnaires.

10. The "OECD mean, OECD average and computation of standard errors of differences" module in these manuals (see: <http://www.oecd.org/pisa/pisaproducts/pisadataanalysismanualspssandsassecondedition.htm>).

In this study, the following two types of indices are used to select the factors determining academic risk:

A. The students' personal and academic characteristics
   Student-level simple indices (five categorical variables): gender; relative grade; home language; repetition; attendance in pre-primary education.

B. The student's home social environment
   Student-level simple indices (three categorical variables): parental education; parental occupation; and family structure; and student-level scale indices (one continuous variable): home possessions.

C. General school characteristics

- School-level simple indices: 13 indices, of which five are categorical variables: school management; location; site; social composition; school selection; and eight are continuous variables: use of assessments; number of students in the class; computers for educational use; extracurricular activities; female composition; availability of computers; number of students at the school; and student-teacher ratio.
- School-level scale indices: 13 indices (continuous variables):
  - School leadership: framing the school's goals and curricular development (LEADCOM); instructional leadership (LEADINST); promoting instructional improvements and professional development (LEADPD); and teacher participation in leadership (LEADTCH).
  - School autonomy (SCHAUTON); teacher participation and autonomy (TCHPARTI).
  - School resources: teacher shortage (TCSHORT); quality of school's educational resources (SCMATEDU); quality of school's physical infrastructure (SCMATBUI).
  - School climate: student-related factors affecting school climate (STUDCLIM); teacher-related factors affecting school climate (TEACLIM).
  - Teacher morale (TCMORALE); teacher focus (TCFOCST).

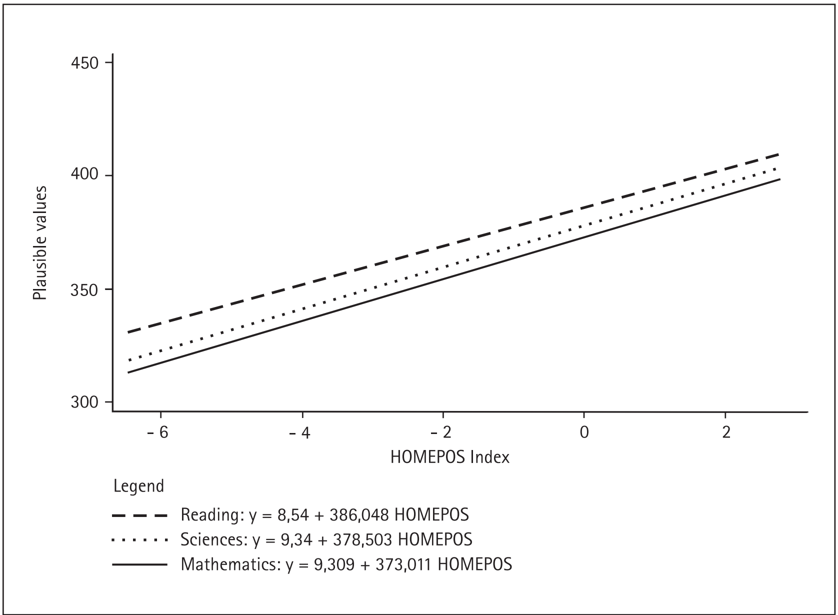
In sum, this arsenal of variables is comprised of nine associated with the student and their social environment; and 26 variables associated with the school.

Notable by its absence is the index of students' economic, social, and cultural status (ESCS), which is used extensively in the studies and combines parental occupation, parental education, cultural possessions, and home educational resources. This index has come under heavy criticism from Guadalupe and Villanueva (2013) due to its lack of reliability in reflecting the changes that occurred in Peru between 2001 and 2012, which were a result of sound economic performance and poverty reduction levels. Therefore, the authors believe that the descriptive capacity of the index is limited, in that it was created for structures that are very different from the local job market.

Nor does the index include the official Peru report (Minedu 2013: 74), instead preferring the Home Possessions index (Homepos), which is comprised of all items from another three indices: household wealth (HWI) (h); cultural possessions (CULTPOSS); and home educational resources (HEDRES), as well as the books at home item, distributed across four categories (0-10 books; 11-25 or 26-100 books; 101-200 or 201-500 books; and more than 500 books).

Given the importance of its use in the official reports, the distribution of the HOMEPOS index by disciplines is set out in Graph 3. The respective equations and the behavior of the gradients illustrate the manner of their association with the achievements across the three competencies.

Graph 3
HOMEPOS socioeconomic index and performance by competency, Peru-PISA, 2012



Source: PISA (2012) database; compiled by the author.

Graph 3 clearly shows that the HOMEPOS index is associated with school performance. An increase in its value is accompanied by an increase, at a different rate, in student performance across all the disciplines assessed. This association has different starting points that are reflected in the constant of each of the equations, and later obtains a slope that is manifested differently depending on the discipline. This HOMEPOS index, which refers to the socioeconomic level of the students, is also used in the social composition of the school, as will be seen later.

For the first stage, the magnitude of the missing values is an important consideration in the selection of variables, since in the multilevel models it has an accumulated effect that can reduce the number of observations available. In the present case, the continuous variables used do not have missing values. As to the context variables, there are only two nominal variables that have a bearing on the model: attendance in pre-primary education and parental occupations, which have 2.8% of these values. Following the general rule proposed by the OECD (2008: 24) applicable to studies on an international scale, no imputation method is employed when the variable has less than 5% of its missing values. This rule is applied here.

A second selection stage involved applying the collinearity test to the set of variables, through which a linear combination is performed between two or more variables; this can cause instability in the regression coefficients and inflation in standard errors, thereby falsifying the significance test. This phenomenon is detected through calculation of the variance inflation factor (VIF). One practical criterion involves setting this conditional index at a value of less than ten. The variables at play have a VIF value of 2.50; thus, all of the variables proposed are retained.[11]

Formally, the equation used for the logistical regression is proposed as follows: Y_{ij} is a binary dependent variable that represents student i at school *j*. The variable *X* contains the set of *k* independent variables and Z_{lj} is the vector of l variables at school level. Once this relationship has been established, the likelihood of an event occurring, such as a student's possession or otherwise of a given characteristic, in this case at or not at academic risk, is defined as $p_{ij} = P(Y_{ij} = 1)$.

11. It should be noted that the variable of age, anticipated at the outset, causes significant inflation due to its collinearity with all the other variables; thus, it does not form part of the model. For a more complete consideration of collinearity, see IDRE (n.d.).

Therefore, the equation is translated with the logistic function:

$$\log\left[\frac{p_{ij}}{(1 - p_{ij})}\right] = \gamma_{00} + \gamma_{10} X_{kij} + \gamma_{01} Z_{lj} + \mu_{1j} X_{ij} + \mu_{0j} + \varepsilon_{ij} \quad (1)^{12}$$

The three first terms allow the fixed effects to be distinguished from the latter two, which constitute the random effects. The logistic model thereby makes analysis possible so as to discern the characteristics of the categories and to accurately assess the role of each in the model.

A reading of the results of the logistic model involves explaining the notion of odds ratio. This is the likelihood ratio of whether an event will occur in a group against the likelihood of whether the same event will occur in another group. For example, when the relationships between two binary variables are set out in a contingency table, the values of two rows (p_1 and p_2) are obtained, and compared with the values of two columns (q_1 and q_2). The combination produces four values. If the likelihoods of the event in each group are p_1 for the first group and p_2 for the second, then the likelihood ratio is:

$$[p_1 / (1 - p_1)] \,/\, [p_2 \,(1 - p_2)] = p_1 q_2 \,/\, p_2 q_1 \quad (2)$$

Thus, a likelihood ratio with a value of 1 indicates that the occurrence of the event is equally likely in both groups; a value greater than 1 indicates that the event is more likely to occur in the first group; and a value of less than 1 indicates that the likelihood of occurrence in this group is lower than in the other. Logistic regression is a way of generalizing the probability ratios beyond two binary variables.

For the logistic regression, or logit model, the coefficients are interpreted similarly to those that are usual in the linear regression between dependent and independent variables. The odds ratio values are those quantities by which the odds that favor the occurrence of an event (likelihood = 1) are multiplied (dependent ratio) by each increase in the unit of the independent variable. To facilitate their reading, the coefficients of each odds ratio are presented in their exponentiated form e^b.

Moreover, it should be noted that the variables of the data analyzed here come from a two-level hierarchy, with a first level of data corresponding to the students and a second regarding the schools.

12. Source: Choi *et al.* (2013: 573).

RESULTS

To determine the performance of students at risk and not at risk, it is recalled that the multilevel model establishes a theoretical relationship between the set of nine variables associated with the students and their social environment, and the 26 variables corresponding to the schools. For the reading of each categorical value associated with the results, one base category is randomly selected to serve as a comparative reference.[13]

For its construction, in this model the value of each variable is read in comparison with the others under the known condition of *ceteris paribus*; that is, the effect that occurs in the dependent variable (at risk/not at risk) due to the change in the unit of a given independent variable, if all other variables remain constant. Table 2 sets out the results in likelihood ratio values; moreover, of the total of 35 ratios that have featured in the model, only those that show statistical significance are included.

Of the set of values anticipated at the start of the modeling, only 11 are found to be significant. The most striking result is the absence of many variables whose influence is considered to be traditional in this type of analysis; this includes parental education, which does not have a bearing on academic risk. Moreover, nor would a school's urban or rural location, or whether it is public or private, have an effect.

However, perhaps the most significant result concerning academic risk is the absence of all significant associations between performance and an important set of variables related to the school. Apart from the number of students in the class and the use of computers connected to the internet for mathematics, none of the other school characteristics are associated with academic risk.[14] It should be recalled that these results are valid insofar as they refer to low-performing students.

13. For the logistic regression model with the at-risk and not-at-risk dichotomous dependent variable, the odds ratios are coefficients of regression expressed as log-odds and are always positive.
14. It is notable that for the Spanish context, Choi *et al.* (2013) arrive at similar conclusions, reporting that the only significant school characteristics are the variable of location in major cities and the ratio of students per computer.

Table 2
Multilevel logistic regressions for students at academic risk: likelihood ratios by competencies and variable categories selected, Peru-PISA 2012 (standard errors in parenthesis)

Variable	Base category	Other categories	Mathematics	Reading	Sciences
Gender	Female	Male	0.414***	1.461***	0.638***
			(0.043)	(0.123)	(0.068)
Home language	Spanish	Other languages	1.940*	2.142***	1.712*
			(0.533)	(0.446)	(0.429)
Relative grade	At grade level	Above grade level	0.543***	0.572***	0.629***
			(0.069)	(0.056)	(0.075)
		Below grade level	2.217***	2.412***	2.238***
			(0.428)	(0.424)	(0.374)
Repetition	Did not repeat	Repeated	2.044**	2.025***	1.755***
			(0.483)	(0.284)	(0.264)
Pre-primary	Did not attend	Attended for one year	0.812	1.039	0.981
			(0.149)	(0.219)	(0.175)
		Attended for more than one year	0.659*	0.950	0.806
			(0.115)	(0.172)	(0.127)
Parental occupation	Skilled	Semi-skilled white collar	1.152	1.357*	1.308
			(0.142)	(0.186)	(0.2076
		Semi-skilled blue collar	1.128	1.567**	1.397*
			(0.151)	(0.254)	(0.227)
		Elementary occupations	1.350	1.696**	1.800**
			(0.250)	(0.289)	(0.363)
Family structure	Single-parent	Two-parent	1.265	1.316*	1.078
			(0.159)	(0.166)	(0.150)
		Multi-parent	2.019***	1.642***	1.876***
			(0.321)	(0.249)	(0.352)
Home possessions (HOMEPOS)			0.811***	0.856**	0.830*
			(0.040)	(0.051)	(0.064)
Social composition of the school	Average	Advantaged	0.349***	0.338***	0.426***
			(0.086)	(0.077)	(0.093)
		Disadvantaged	1.693*	1.506	1.590
			(0.434)	(0.344)	(0.376)
Class size by number of students	Small	Medium	0.497*	0.646	0.505*
			(0.152)	(0.173)	(0.151)
		Large	0.337**	0.553	0.352**
			(0.128)	(0.200)	(0.137)
Computers connected to the internet			0.614*	0.662	0.661
			(0.150)	(0.150)	(0.167)
Costant			3.501***	1.333*	2.720***
			(4.18)	(1.84)	(3.76)

Note
Significance level probability: * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.
Source: PISA (2012) database; compiled by the author.

Only those variables found to be statistically significant in the model proposed will be referred to below.

1. Student personal and academic characteristics

A. Gender

Male students are 46.1% more likely to be at risk in reading compared to their female counterparts. Conversely, they are exposed to less risk in the case of mathematics and sciences. This may be explained by the differing behavior of male students, who spend more time playing video games and dedicate less hours to homework and to reading for pleasure (OECD 2015). Given that reading forms the basis of learning, this will affect their performance. These gender-based differences in each competency merit complementary analysis in order to provide robust explanations.

B. Home languages

In the sample of students, 9% live in homes where a language other than Spanish, the testing language, is spoken. A comparison with students in whose homes Spanish is spoken shows that students from non-Spanish-speaking homes are subject to almost twice as much risk across all competencies, especially reading. However, there have been experiences with a bilingual intercultural approach (albeit only in the case of primary education) where no significant differences were found between Spanish-speaking monolingual students and their bilingual counterparts in the areas of mathematics and reading (Cueto and Secada 2003); this points to the importance of taking into account specific cultural and linguistic characteristics in the provision of education to each community.

C. Relative grade

Relative grade is the name of the PISA variable that records whether a student is below their grade level; a student who enrolls in a timely manner should normally be in the fourth grade of secondary education - the modal grade corresponding to the age of 15 - at the time they take the test. Those students studying at a lower grade are said to be "below grade level," while those in a higher grade are "above grade level." Of the total, 28.6% of students are classed as being below grade level. However, it should be borne in mind that relative grade as defined here may contain effects that are isolated and the sum of several factors: late or early enrollment of the child, grade repetition, dropping-out and re-enrollment, and voluntary breaks.

The below-grade-level variable is extremely important, as it applies to around 28% of students in the sample. However, in the case of at-risk students, this value is extremely concerning, affecting around 90% of all individuals across all competencies (see Annex 2).

This is confirmed by the values of the model, where below grade level students are twice as likely to be at academic risk across all competencies as their counterparts in the expected grade. Of course, being below grade level is not due to chance or schooling alone.[15]

Being above grade level affords better prospects of avoiding a situation of risk than being at the expected grade level in almost all cases, with the likelihood falling by half.

D. Grade repetition

Of course, repetition and below grade level status go hand in hand, although repetition is not the only cause of lag, which is a very important factor in a country where late enrollment is minimal and the repetition of first grade was eliminated in 1995. In PISA 2012, 27.5% of students were found to have repeated, but in the case of students at risk, the proportion rose to almost 90%. Indeed, the likelihood of a repeating student being at academic risk is 75.5% higher than for a student who has never repeated in the case of the sciences, while in mathematics and reading the likelihood is double.

Although this is not comparable in the cycle studied here, the analysis of factors associated with the performance of fourth and sixth grade students in 15 Latin American countries would suggest the need to replace grade repetition with another educational mechanism, given that it is one of the factors with a high negative relationship with performance (UNESCO-TERCE 2015: 7). As well as being an ineffective mechanism, repetition can cause problems of personal stigmatization, demotivation, and a deterioration in the classroom environment, all of which makes learning more difficult.

Repetition as a mechanism for regulating schooling progress is increasingly being called into question, and some have even recommended its elimination as a costly and ineffective practice that, as well as failing to guarantee improved results, reinforces socioeconomic inequalities by more severely castigating disadvantaged students (OECD 2012). However, tackling repetition would have implications for both the institutional school structure and its traditional social and cultural roots.

15. It would be interesting to establish, for 2012, the relationship between grade repetition and undernourishment, as found by the 1999 national height survey of Peruvian students. See Guadalupe and Villanueva (2000).

E. Attendance in pre-primary education

It is common to find a strong association between prior attendance in pre-primary education and later student performance (OECD 2014b). For the case of Peru, 86% of students who took the PISA test attended pre-primary education, and early schooling is also found to have effects on the results for mathematics, where there is less risk (odds of 0.659) compared with other students who did not access this type of education.

This result leaves no doubt as to the benefits of pre-primary education, but it is not clear why its effect may be valid for one discipline in particular but less so for another, while also taking into account that the education process begins with early stimulation that goes beyond mere transmission of knowledge.

2. Social environment of the home

F. Parental occupation

This variable is based on the students' responses about their parents' occupational status. The responses were coded using the categories of the International Standard Classification of Occupations (ISCO-88), the occupational classification used by the International Labour Association. However, this and its associated indices are highly criticized in social research, due to both the definitions set out in the job content of each category and the details of the codes.[16]

Thus, from the database, in the case of Peru it is possible to identify 286 different employment categories for the father and 211 for the mother. This classification is unwieldy for an analysis of categorical data. Therefore, the abbreviated version is used here - with the severe loss of information that this entails - which includes the four categories proposed by the OECD: skilled, semi-skilled white-collar, semi-skilled blue-collar, and elementary occupations.[17] Because both fathers and mothers were surveyed, the database allows the assignment of the highest relative occupational category of the two parents, and the construction on this basis of a single parental variable (Graph 4).

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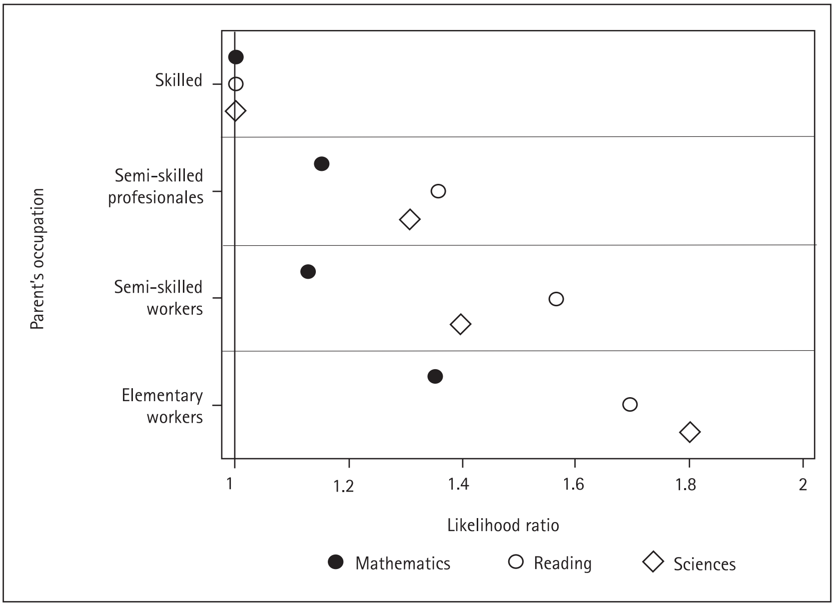
16. In particular, the Highest Parents' Socio-economic Index (HISEI), which ranks each country according to an index that apportions "social scores (status)" to both parents and is extensively used in PISA reports, has come in for criticism.
17. Skilled groups together the ISCO categories 1, 2, and 3 (legislators, executives, managers, officials and experts, and professionals); white-collar comprises ISCO categories 4 and 5 (service workers, salespersons, and clerks); blue collar encompasses ISCO categories 6, 7 and 8 (skilled agricultural and fishing workers, craft workers, and trades workers); and elementary workers are made up of the ISCO category 9 (machine operators, production workers).

Graph 4
Academic risk, parental occupation, and likelihood ratio, Peru-PISA, 2012 (base: Skilled)



Source: PISA (2012) database; compiled by the author.

In most of the PISA 2012 countries, those students whose parents work in elementary occupations have a lower performance in all cases (OECD 2014c). In Peru, although the parents of 22% of all students have jobs in this category, the parents of 92.8% of students at risk hold basic occupations (see Annex 2). Across all competencies measured, those students whose parents work in such occupations are those who are most affected by academic risk. Graph 4 shows the prevailing gaps in risk according to parental social origin and the likelihood ratio.

Taking parents with a skilled occupation as a reference category, social differentiation emerges in a clear and statistically significant manner: students from families whose parents are skilled are always less likely to form part of a group of at risk students across all competencies and compared with all other occupational categories. Conversely, these likelihoods are between 70% and 80% greater in reading and sciences for students whose parents are in elementary occupations.

It is notable that according to the model's odds ratios, only in the case of mathematics is there no significant academic risk-related effect associated with parental occupation. Given that parental occupation likewise has no bearing on the model, this result, due to its independence from social origin, is of enormous benefit in preparing education proposals in this discipline.

G. Family structure

In all cases, living in a multi-parent family (a family other than that formed with parents) has significant unfavorable effects across all competencies. This situation could result in a student being twice as likely to be at risk compared with a student living in single-parent family (base of comparison). It is noteworthy that in reading, belonging to a two-parent family is associated with greater risk of low performance than in the case of a single-parent family. Although the data do not provide an explanation, a cause for celebration is the existence of "mother courages," who constitute 84% of single-parent families in the study and support greater attainment by their children, albeit only in reading. Many important aspects remain to be explored as regards the influence of the family: size, siblings, parental involvement, family income, family work, and so on. These aspects undoubtedly affect and have affected a student's schooling and academic performance, but little to nothing is known about them. The importance of the role of the family in academic performance is worthy of urgent attention.

H. Home possessions (HOMEPOS)

As stated, the HOMEPOS index is preferred to the ESCS in measuring students' socioeconomic and cultural status. Graph 3 sets out the straight-line values of the HOMEPOS variable by competencies for the sample in general. When only students at risk are referred to, the values of the slopes are 13.7 points in mathematics, 14.4 in sciences, and 15.6 in reading.[18] Their values are always positive and diverse, and clearly demonstrate the differential effect of social status on performance.

Table 2 provides another way of reading the values. Indeed, an always positive increase in the value of the HOMEPOS index gives rise to a lesser probability of encountering risk[19] across all competencies. The importance of this index is confirmed in this way.

18. According to the author's own calculations. When ESCS is used instead of HOMEPOS, the values are similar and vary by around 16 points for mathematics and sciences, and 17 points in the case of reading.
19. Odds coefficients of 0.811, 0.856, and 0.830 in mathematics, reading, and sciences, respectively (Table 2).

However, the substantial differences noted between the slopes at the national level and those of the at-risk population pose questions regarding the variance in the achievements at student and school level when the socioeconomic status index is taken into account. To illustrate this, the intra-class correlation coefficient is employed, which allows these two components to be discerned. Thus, using the HOMEPOS index, the existing variance between the schools would explain 40.9% of the results in mathematics, 44.7% in reading, and 39.9% in the sciences.[20] The remainder in each case would correspond to the variance between students.

These variances are almost halved when the same calculations are performed for at risk students: 22.4%, 27.1% and 22.2% respectively, in mathematics, reading, and the sciences. In other words, for these students the schools are more homogeneous and the differences are attributed mainly to the characteristics of the students themselves.

3. General characteristics of the school

As stated, of the set of 26 variables in the model that profile the characteristics of the school, only social composition, number of students in the class, and the availability of computers are significant for mathematics.

I. Social composition of the school

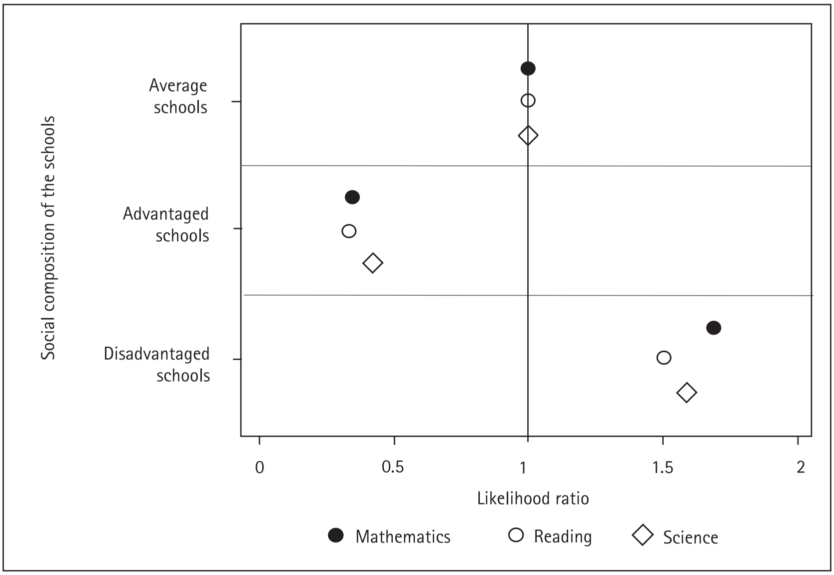
According to the report of Coleman *et al.* (1966), socio-economic backgrounds have been identified as the best predictor of school performance. The various studies in this regard confirm that this observation holds firm over time and is valid for a number of competencies and school systems (Sirin 2005; Monseur and Crahay 2008). Of course, the social characteristics of a student who attends a given school do not arise by chance, being accompanied as they are by social and cultural "capital" that takes root starting from the years before enrollment in the school system. What is required, then, is to investigate whether social composition brings about significant differences in performance.

To establish this variable in the schools, the OECD (2013a: 49) uses the ESCS index as criteria and classifies it into three socioeconomic types. In this study, in accordance with the previous decision to employ the HOMEPOS variable, the social composition variable also serves to classify the schools into three economic types. Each school has a HOMEPOS

20. These percentages are not strictly those published by the OECD (2013b: vol. II), which are corrected and aligned on the basis of the average of all participating countries and territories. In this study, the variations are calculated by applying the intra-class correlation coefficient (rho), and by respecting the five plausible values and the multi-level data structure.

average, which is that of the HOMEPOS values of the students of which it is comprised. If the value of the HOMEPOS index corresponding to each school and the value of the national average HOMEPOS index are not significantly different to the 95% confidence level, the school is classified as an average school. On the other hand, schools are classified as advantaged when the difference is positive, and disadvantaged when the difference is negative (Graph 5).

Graph 5
Academic risk, likelihood ratio, and social composition of the schools, Peru-PISA, 2012



Source: PISA (2012) database; compiled by the author.

Taking the average school as a baseline, Graph 5 shows that socially advantaged schools are wholly distinct from all other schools across all competencies: their likelihood of having at-risk students are lower in all cases compared with a socially average school, and much higher than those classified as disadvantaged.

Indeed, Table 2 presents the odds coefficients, which are always lower than the unit in advantaged schools, while in the case of students at disadvantaged schools the coefficient reaches 1.69 for mathematics; that is, their likelihood of poor performance is 69% greater. It is important to point out that in the case of the sciences and reading, the coefficients are not significant and as such are not affected by the social composition of the schools.

Solely by way of reference and as an aid to interpretation, it is worth noting that 30% of those students whose parents work in skilled occupations, and 48% of those whose parents are educated to higher level, are educated at advantaged schools.[21]

Naturally, families do not leave their choice of school to chance but nor do they do so based on obtaining good results in one discipline or another. Little to nothing is known about the mechanism(s) of social selection and self-selection, but they certainly exist and ought to be explored.

J. Number of students in the class

The number of students at a school and in a class never fails to spark debate on the education policy agenda with regard to parental preferences, effects on earnings, teaching time, learning opportunities, and professional teaching development. In this case, it is found that the more students there are in the class, the lower the likelihood of poor results being attained in mathematics and the sciences. For reading, no significant influence is found when the class contains more students than the average (28 students). The reasons behind this fact have yet to be explored, especially with regard to the lack of an effect on reading. It is worth recalling that Hanushek and Woessmann (2010: 17) have already pointed out that policies based solely on the size of the school and on the provision of material resources have little hope of prompting an upturn in achievements, given their absence of effects.

K. Computers connected to the internet

The COMPWEB index - which relates the number of computers used for educational purposes connected to the internet to the overall number of computers in the school - is significantly and solely associated with mathematics. In schools, where a student can use a computer, their likelihood of performing poorly decreases (odds 0.61). It should be noted that the fact of possessing a computer at the school, measured by the RATCMP15 index - which relates the availability of computers used for educational purposes to the number of students - is insufficient if the computer is not connected to the internet but is used for learning. Indeed, this index was not used in the present model because it does not prove to be significant.

For the remaining competencies, although no effects are identified, this is not to say that learning depends solely on the availability of IT devices as a means of obtaining high scores.

21. The change in the baseline does nothing to alter the landscape: for instance, in the case of mathematics, if disadvantaged schools are taken as the reference, significant odds ratios of 0.59 with respect to average schools and of 0.20 with respect to disadvantaged schools are obtained, and a risk considerably lower than 1 is reported; this confirms the significant contrast that socially distinguishes disadvantaged schools.

Thanks to the presence of computers, the digital era offers students a wealth of knowledge that is not necessarily measured by tests.

CONCLUSIONS

The education process takes place at schools, which are tasked with the comprehensive development of students. Exploring the extent to which these institutions provide high-quality education and equal opportunities without perpetuating social and economic gaps is something that cannot be overlooked. Therefore, an interest in the dimension of academic risk and attempts to measure the importance of a student's personal, family, and school characteristics, as well as the characteristics of the school itself, is one way of exploring the factors that drive or restrict improvements in performances.

The PISA database is extensive, but comes with the caveat that its indices and variables conform to the framework of PISA's work. Therefore, for this study, only those variables whose objectives can be most readily translated and which have demonstrated their relevance in other research studies have been selected.

Moreover, it will have been noted that no interaction between the variables is presented intentionally. Including all possible combinations would have exponentiated the model, rendering it illegible. These combinations undeniably exist and may conceal dimensions that would not be possible to detect here. This constitutes both a limitation - to be taken into account in the use of the results of the information presented - and a future challenge.

The analyses abundantly confirm that the student's socioeconomic environment is the greatest determinant of academic risk. Being below grade level, a home language other than Spanish, grade repetition, school composition, multi-parent family structure, and parental occupation are also appreciably associated with low performance across the three disciplines. With the exception of the use of computers connected to the internet and the number of students in a class, the model used stresses the lack of an association between all other indicators concerning the school.

On the other hand, generally-significant differences found between public and private schools and between urban and rural schools (OECD 2013a, 2011), valid for the entire set of students, appear not to be present in the case of those at academic risk in the Peruvian case. To be sure, these absences of association are conditioned by the type and quality of the variables used in the model and even by the model itself, since that which is measurable is not the only factor that counts when explaining low performance.

In mathematics, the typical profile of an at-risk student are youth from a disadvantaged social background who also attend a socially disadvantaged school; moreover, they have not attended pre-primary school, have repeated a grade at least once and are below their grade level; they belong to a multi-parental family; their parents work in elementary occupations; a language other than Spanish is spoken at home; and they learn in a class alongside almost 28 classmates. With very subtle nuances, this is also the profile of students at risk in the sciences and reading.

Academic risk is the product of multiple factors, and attempts have been made to identify and measure these. Although the analyses that have appeared in the literature do not establish causalities, the findings do help in proposing a number of policy actions.

- Students and schools actively or potentially at risk should be identified in order to design inter-sectoral policies that link educational and social aspects in the communities where vulnerable schools are located.

- Grade repetition has a strong negative association with performance across all competencies without exception, and is probably explained by certain specific school and family mechanisms. However, the benefits of repetition on school results is increasingly being called into question. And in those cases where repetition is presumed to be necessary and beneficial, its financial costs and, of course, its impact on the student's self esteem and the family's attitude must be taken into account.

- Being below grade level, undeniably associated with repetition, markedly accompanies low student performance across all disciplines. This phenomenon has its roots in school and social factors, which urgently need to be identified in order to take actions in response.

- Gender differences in performance must be corrected. In reading, male students are more likely to be at risk than their female counterparts. Conversely, females are more at risk than males in mathematics and sciences. Clearly, the explanation is not genetic, but the factors at play warrant further supplementary analysis.

- Students who live in multi-parental families should receive assistance. The role of siblings, grandparents, and other relatives merits particular attention to understand the implications of the family for the life of the student and the school.

- Given that almost 90% of students whose home language is not Spanish are situated below Level 2 across all competencies, there would appear to be an urgent need to assure better basic conditions in the implementation and development of the bilingual intercultural education (BIE) model, involving bilingual teachers, adequate educational materials, and teacher training, among other features. Although PISA assesses 15-year-old students, the level of development of their competencies depends on their educational background at the pre-school, elementary, and early-secondary levels.

While education concerns not only performance but also personal, intellectual, ethical, emotional, civic, and social development, the importance of the issue of low academic performance cannot be overlooked. Academic risk is not due to misfortune, having always been present in the functioning of the education system, but has been of little, if any, interest. As Demeuse *et al.* (2001: 65), point out, modern democratic societies must not stop reconciling efficiency in academic results with equal opportunities; while they may appear contradictory, both exigencies will necessarily converge with the ongoing expansion of education.

The analyses carried out in this study show that low performance is not due to any single factor but rather the combination and accumulation of several barriers and disadvantages in a student's schooling. Education policy needs to identify the educational situation and the family context of these vulnerable students on an ongoing basis. International surveys enable the comparison of useful experiences, but are of limited use in guiding national policy. The construction of panel or longitudinal databases in national assessments, accompanied by educational and social research targeted to disadvantaged social sectors, can contribute to implementing immediate and prospective remediation policies with a view to eliminating the risk of low performance.

ANNEXES

Annex 1
Performance levels by competency

Level	Mathematics	Reading	Sciences
6	Students can conceptualize, generalize, and utilize information based on their investigations and modeling of complex problem situations. They can compare different sources of information and types of representations. They are capable of advanced mathematical thinking and reasoning. They can apply their insight and understandings along with a mastery of symbolic mathematical operations and relationships to develop new approaches and strategies for attacking novel situations. Moreover, they can formulate and precisely communicate their actions and reflections regarding their finding, representations, arguments, and the appropriateness of these to the original situations.	Students can make inferences, comparisons, and contrasts that are both detailed and precise. In addition, they can demonstrate a full and detailed understanding of one or more texts, which may involve integrating information from more than one text. They are capable of dealing with unfamiliar ideas, in the presence of prominent competing information, and to generate abstract categories for subsequent interpretations. They can critically evaluate a complex text on an unfamiliar topic or hypothesize about these texts. To this end, they must take into account multiple criteria or perspectives, and apply sophisticated understandings from beyond the text. They are capable of precision of analysis and fine attention to detail that is inconspicuous in the texts.	Students can consistently identify, explain and apply scientific knowledge and knowledge about science in a variety of complex life situations. They can link different information sources and explanations and use evidence from those sources to justify decisions. They demonstrate advanced scientific thinking and reasoning, and they use their scientific understanding in support of solutions to unfamiliar scientific and technological situations. Students at this level can use scientific knowledge and develop arguments in support of recommendations and decisions that center on personal, social or global situations.
5	Students can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can select, compare, and evaluate appropriate problem solving strategies for dealing with complex problems related to these models. They use well-developed thinking and reasoning skills, appropriate linked representations, symbolic and formal characterizations, and insight pertaining to these situations. They can reflect on their actions and formulate and communicate their interpretations and reasoning.	Students can locate and organize several pieces of deeply embedded information, inferring which information in the text is relevant. Moreover, they are capable of a full and detailed understanding of a text whose content or form is unfamiliar, as well as of concepts that are contrary to expectations. In turn, they are capable of critical evaluation or hypothesis, drawing on specialized knowledge	Students can identify the scientific components of many complex life situations, apply both scientific concepts and knowledge about science to these situations, and can compare, select and evaluate appropriate scientific evidence for responding to life situations. Students at this level can use well-developed inquiry abilities, link knowledge appropriately and bring critical insights to specific situations. They can construct explanations based on evidence and arguments based on their critical analysis.

Level	Mathematics	Reading	Sciences
4	Students can work effectively with explicit models for complex concrete situations that may involve constraints or call for making assumptions. They can select and integrate different representations, including symbolic ones, linking them directly to aspects of real-world situations. Moreover, they utilize well-developed skills and reason flexibly, with some insight, in these contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments, and actions.	Students can locate and organize several pieces of embedded information in the text. They are capable of interpreting the meaning of nuances of language in a section of text by taking into account the text as a whole. Moreover, they are capable of understanding and applying categories in an unfamiliar context, as well as using formal or public knowledge to hypothesise about or critically evaluate a text. In addition, they can understand long or complex texts whose content or form may be unfamiliar.	Students can work effectively with situations and issues that may involve explicit phenomena requiring them to make inferences about the role of science or technology. In addition to this, they can select and integrate explanations from different disciplines of science or technology and link those explanations directly to aspects of life situations. They can reflect on their actions and they can communicate decisions using scientific knowledge and evidence.
3	Students can execute clearly described procedures, including those that require sequential decisions. Their interpretation are sufficiently solid to form the basis for the construction of a simple model or to select and apply simple problem solving strategies. Moreover, at this level they can interpret and use representations based on different information sources and reason directly from them. In addition, they can develop short communications reporting their interpretations, results and reasoning.	Students can locate, and recognize the relationship between, several pieces of information that must meet multiple conditions. They can integrate several parts of a text in order to identify a main idea, understand a relationship or construe the meaning of a word or phrase. They are capable of taking into account many features in comparing, contrasting or categorizing. They can locate information and other text obstacles, such as ideas that are contrary to expectation or negatively worded. They can make connections, comparisons, and explanations, or critically evaluate a specific feature of the text. Finally, they are capable of demonstrating a fine understanding of the text in relation to familiar, everyday knowledge, and can reflect on a text by drawing on less common knowledge.	Students can identify clearly described scientific issues in a range of contexts. They can select facts and knowledge to explain phenomena and apply simple models or inquiry strategies. They are able to interpret and use scientific concepts from different disciplines and can apply them directly. Moreover, at this level they can develop short statements using facts and make decisions based on scientific knowledge.

Level	Mathematics	Reading	Sciences
2	Los Students can interpret and recognize situations in contexts that require no more than direct inference. They can extract relevant information from a single source and make use of a single representational mode. They can employ basic algorithms, formulae, procedures, or conventions. They are capable of direct reasoning and making literal interpretations of the results.	Students can locate one or more pieces of information, which may need to be inferred and may need to meet several conditions. They are capable of comparisons or contrasts based on a single feature in the text. Moreover, they can recognize the main idea in a text, understand relationships, and construe meaning within a limited part of the text and when low level inferences are required.	Students have adequate scientific knowledge to provide possible explanations in familiar contexts or draw conclusions based on simple investigations. They are capable of direct reasoning and making literal interpretations of the results of scientific inquiry or technological problem solving.
1	Students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are obvious and follow immediately from the given stimuli.	At Level 1a, students can locate one or more independent pieces of explicitly stated information, recognize the main theme or author's purpose in a text about a familiar topic, or make a simple connection between information in the text and common, everyday knowledge. They can locate prominent information in the text when there is little, if any, competing information. At this level, the questions explicitly direct students to consider relevant factors in the task and in the text. At Level 1b, students can locate a single piece of explicitly stated information in a prominent position in a short, syntactically simple text with a familiar context and text type. Moreover, they can make simple connections between adjacent pieces of information.	Students have such a limited scientific knowledge that it can only be applied to a few, familiar situations. They can present scientific explanations that are obvious and follow explicitly from given evidence.
Below 1	Students are, at best, capable of performing very direct and simple mathematical tasks. This may include reading a single value from a simple graph or table in which the labels coincide with the words in the stimuli and the question, such that the selection criteria are clear and the connection between the table and the aspects of the described context are evident. Moreover, they can perform basic arithmetical operations by following clear and well-defined instructions.	Students who are incapable of performing the tasks required of Level 1 are included at this level.	Students who are incapable of performing the tasks required of Level 1 are included at this level.

Source: OECD (2013b).

Annex 2

Students at academic risk: likelihood ratios by competencies and variable categories selected, Peru-PISA 2013 (percentages and standard errors in parenthesis)

Variable	Categories	Mathematics	Reading	Sciences
Gender	Female	77.4 (2.15)	54.8 (2.42)	69.0 (2.38)
	Male	71.4 (1.85)	64.9 (1.87)	67.3 (2.10)
Relative grade	At grade level	71.3 (2.16)	53.6 (2.23)	63.4 (2.39)
	Above grade level	57.8 (2.51)	38.5 (2.36)	51.7 (2.65)
	Below grade level	93.8 (1.00)	87.6 (2.27)	89.9 (1.39)
Pre-primary	Did not attend	90.7 (1.29)	78.7 (2.19)	84.7 (2.02)
	Attended for one year	79.2 (1.88)	63.9 (2.18)	71.5 (2.11)
	Attended for less than one year	68.4 (2.24)	52.4 (2.33)	61.2 (2.42)
Repetition	Did not repeat	67.4 (2.10)	49.7 (2.13)	60.2 (2.22)
	Repeated	92.8 (0.95)	85.4 (1.22)	88.1 (1.46)
Family structure	Single-parent	68.6 (2.41)	52.3 (2.92)	63.0 (2.72)
	Two-parent	73.4 (1.71)	59.0 (2.10)	66.4 (2.18)
	Multi-parent	85.0 (1.67)	69.9 (2.18)	80.5 (1.81)
Parental occupation	Skilled	52.1(3.55)	33.1(2.80)	43.8 (3.28)
	Semi-skilled white-collar	71.2 (1.97)	53.6 (2.31)	63.7 (2.38)
	Semi-skilled blue-collar	79.9 (1.61)	66.5 (2.29)	74.2 (1.94)
	Elementary occupations	92.8 (1.02)	83.8 (1.42)	88.8 (1.71)
Language	Spanish	72.6 (1.80)	57.0 (1.98)	66.0 (2.02)
	Others	90.8 (2.07)	84.4 (2.65)	86.7 (2.58)
Social composition	Average	82.3 (1.73)	65.5 (2.66)	73.6 (2.33)
	Advantaged	47.1 (3.11)	27.9 (2.72)	40.8 (2.97)
	Disadvantaged	93.5 (0.97)	84.7 (1.43)	89.3 (1.34)
Class size	Small	87.7 (2.04)	77.7 (2.60)	83.6 (2.27)
	Medium	73.2 (4.32)	57.8 (4.30)	66.9 (3.33)
	Large	65.6 (3.29)	48.5 (3.65)	56.9 (3.46)

Source: PISA (2012) database; compiled by the author.

Annex 3
Continuous variables, Peru-PISA, 2012 (average, percentiles and standard error in parentheses)

Varialbles	Average	Percentile 25	Percentile 50	Percentile 75
HOMEPOS	- 1.36	- 2.19	- 1.31	- 0.5
	(0.045)	(0.047)	(0.014)	(0.178)
COMPWEB	0.654	0.259	0.833	1.0
	(0.024)	(0.127)	(0.22)	(0.05)

Source: PISA (2012) database; compiled by the author.

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