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The role of parents, teachers, and pupils in IQ test scores: Correlates of the Programme for International Student Assessment (PISA) from 74 countries

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ABSTRACT

This study reports the associations between the intelligence of over half a million 15-year-olds in 74 countries, assessed by the 2018 *Program for International Student Assessment* (PISA) and their socio-economic and psychological correlates. Correlational analysis indicates that an individual's average PISA score in 2018 significantly correlated with parental education, pupils' attitudes to teaching and learning in schools, student academic confidence in reading, parental support, school motivation, self-esteem and self-determination. Regression analyses showed six variables that were significant predictors of average scores, accounting for 24 % of the total variance: maternal and paternal education, students' academic confidence in reading, school motivation, and self-determination. The strongest predictor of the average IQ was academic confidence in reading ($\beta = 0.36$, $p < .001$), followed by maternal education ($\beta = 0.16$, $p < .001$). Implications and limitations of this research are discussed.

1. Introduction

The debate about the major determinants of intelligence is as old as it is controversial (Jensen, 1969; Pinker, 2003: Ritchie & Tucker-Drob, 2018; Sauce & Matzel, 2018). Whilst nearly all accept that there is some heritable, biological component, there is less agreement about the environmental factors involved (Lynn, 2017; Marks, 2014; Plomin, 2018). Just as controversial is the research on how best to boost IQ, particularly in socially deprived groups (Stankov & Lee, 2020). Related to this, is the focus of this paper, namely the role played by parents, teachers and schools in fully developing IQ and as a consequence school grades.

This study looks at the correlates of academic proficiency (IQ) in over 600,000 students in many countries. However, what is most important is to establish cause and effect relationships in this field, which requires longitudinal research.

The *Program for International Student Assessment* (PISA) is a triennial survey of 15-year-old students that assesses the extent to which they have acquired the knowledge and skills essential for full participation in society. The assessment focuses on proficiency in reading, mathematics, and science, which according to the analysis of Pokropek et al. (2022), essentially measures general intelligence (*g*). A large number of papers have examined the PISA database (Haw & King, 2023; Hopfenbeck et al., 2018; Nilsen & Teig, 2022; Zheng et al., 2022). Some were interested in specific country results while some used country as a dummy variable looking at overall results.

Approximately 600,000 15-year-old students from 79 countries participated in PISA-2018 research (OECD, 2019). We focus on three factors available in a large data set: *pupils;* gender, self-esteem, self-determination, self-assessed reading competence and school motivation; *parental* education and support*;* and attitudes to *teachers.* As far as we know, these variables have not been investigated together. Our focus was on the regression attempting to establish the relative power of the different variables we had available on their overall (IQ) score.

A prominent area of debate is the role of different factors in determining young people's academic attainment. Some researchers have taken a strong position on these issues. For instance, Detterman (2016) argued that evidence has accumulated suggesting that only about 10 % of school achievement can be attributed to schools and teachers while the remaining 90 % is due to characteristics associated with students.

In this study, we had three categories of variables that allowed us to look at their association with IQ.

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2. Pupil factors

In this data set, we considered student gender, self-esteem, self-rated ability, self-determination and school motivation, each of which has been previously examined and shown to relate to ability/IQ measures (Giofrè et al., 2022; Singh et al., 2002). Our question was the interrelationship between these variables and their relationship with the outcome PISA scores.

We first investigate sex differences in IQ, a well-researched and highly controversial topic (Eagly & Revelle, 2022; Halpern et al., 2011). There have been arguments with supporting data for a male advantage (Lynn et al., 2017), for no difference, and for a female advantage. For instance, Voyer and Voyer (2014), in a large meta-analysis, demonstrated the presence of a stable, female advantage in school marks. Yet they also identified critical moderators dependent on the tests used, and the age of the participants. This literature suggests that even though sex differences are very small, they are impacted by what is assessed and how (Johnson et al., 2008). While we believe data suggests a small, albeit significant, sex differences at the facet level, we hypothesise there would be no overall significant sex difference in IQ.

Next, we explore measures of *self-assessed competence.* There is a vast and growing literature in this area which suggests three things: there is a modest positive correlation between self-estimated and test-derived scores ($0.30 < r < 0.50$); females tend to give lower estimates than males, more for mathematical and spatial tests than those of language; these estimates are influenced by personality factors, especially Conscientiousness and Neuroticism (Ackerman & Wolman, 2007; Freund & Kasten, 2012; Furnham & Grover, 2020; Herreen & Zajac, 2018). Hence, we predicted a strong positive correlation between self-assessed and actual scores.

Third, we also obtained data on *students' self-esteem (SE)* which has been extensively investigated and shown to be a cause and consequence of academic success. Whilst studies revealed it is possible to differentiate between different types of self-esteem (e.g. intellectual, physical) (Furnham & Cheng, 2000), they are highly correlated. Further, people with high self-esteem tend to be more self-confident in many areas of life. Though it is unclear how self-esteem is developed and maintained, it is apparent that it relates to educational success (Baumeister et al., 2003). In an early study, based on four cohorts of children in 6th to 9th grades, Alsaker (1989) found that school achievement was significantly correlated with global negative self-evaluations ($r = -0.20$) and self-perceived academic competence ($r = 0.65$). In a comparative study of adolescent students in England and the United States, Booth and Gerard (2011) examined the links between self-esteem and academic achievement from the beginning to the end of their academic year during their 11th and 12th years. They found that self-esteem was related to multiple indicators of later-year academic achievement. Numerous studies have demonstrated that higher levels of motivation are related to higher grades in maths and reading (Broussard & Garrison, 2004; Mitchell, 1992). Thus, we predicted a significant positive correlation between SE and PISA scores.

Next, we examined *self-determination,* which also links to educational outcomes (Guay, 2022). Self-determination is conceptualised as the inherent human tendency toward psychological growth, independence and improved well-being. Jeno et al. (2018) reported a positive effect of self-determination on academic achievement. León et al. (2015) discovered that autonomy predicts autonomous motivation, which, in turn, has a positive impact on effort regulation and deep processing, and that both variables predict math achievement. We expected positive correlations between scholar self-determination and IQ results.

3. Parent factors

In this study, we had two parental factors: *parental educational attainment* (the education level of the mother and father (separately) and *student-perceived parental support.* We expected both to be positively and significantly related to the PISA score. Parental education has been linked to academic achievement in previous cross-sectional and longitudinal studies. For example, in examining the long-term effects of parental education, Dubow et al. (2009) found that parents' educational level, measured when the child was eight years old, significantly predicted educational and occupational success for the child 40 years later. Using a population-based sample of Finnish students (aged 9, 12 and 15 years, $n = 982$), Keltikangas-Järvinen et al. (2010) revealed the HTR2A gene moderated the association between maternal education and the child's grade point average. In a recent systematic review and meta-analysis based on 38,654 families across eight cohorts from different countries, Wang et al. (2021) discovered that genetic nurture effects captured by polygenic scores explained at least 1.28 % of the variance in educational outcomes, while direct genetic effects explained at least 2.89 % of the variance in educational outcomes. The researchers argue that these findings are underestimated, given that polygenic scores only capture a fraction of heritability in educational outcomes the actual genetic effects could be many times higher.

Various studies have shown associations between parental involvement and students' academic achievement (Boonk et al., 2018). For instance, a study by Ugwuanyi et al. (2020) found that parental support plays a significant role in senior secondary learners' performance in Physics ($r = 0.41$). In another study, using data from 7430 9th and 10th graders in Iceland, Kristjansson and Sigfúsdóttir (2009) demonstrated that parental factors (parental support, parental monitoring, and time spent with parents) all associated with academic achievement among both boys and girls. Ullah et al. (2018) exhibited that teachers' positive attitudes, use of understandable language, and ability to motivate and provide teaching material contribute to students` academic achievements in mathematics.

In an important cross-cultural study Rindermann and Ceci (2018) found parental education showed a stronger impact on children's intelligence than familial economic status. They argued that parental education was a proxy for ability and was associated through childrens' reading, though their book ownership, which in turn related to their childrens thinking and reflection.

Hence, we predicted significant positive correlations between parental factors (education and support) and the children's IQ score.

4. Teacher factors

Several studies have examined the role of teachers in children's school outcomes. For instance, Guimond et al. (2023) looked at teacher's use of praise and punitive discipline in predicting academic achievement. Further research explored the effects of similarities in personality between teacher and pupil (Chamorro-Premuzic et al., 2008; Pancorbo et al., 2021), in addition to preferences for particular teacher characteristics and personality. All the results suggest that pupil's liking of their teachers is related to their success at school, and thus, again we expect a significant positive correlation.

5. This study

The current study investigated the associations between the average PISA scores in 2018 and a set of psychological measures, including teachers' attitudes to teaching and learning in schools, students' academic confidence, parental support, school motivation, self-esteem and self-determination. This was measured among individual students aged 15 in a large and international sample, with over half a million students from 74 countries. Through correlations and regressions, we sought to determine which of our factors listed above was most closely related to individual PISA scores.

6. Method

6.1. Sample

Approximately 600,000 students aged 15 participated in the Programme for International Student Assessment (PISA) in 2018 (OECD, 2019). They completed tests of Reading, Maths and Science, with each test consisting of 10 items. A set of psychological variables were also included in the PISA 2018.

6.2. Measures

1. *Parental education.* This was measured by five levels. (1) He/She did not complete International Standard Classification of Education (ISCED); (2) level 1; (3) level 2; (4) level 3B, 3C; (5) level 3 A.
2. *Attitudes to Teachers.* This was measured by a set of short scales (3–6 items each), including teachers' competence, enthusiasm, preparation, helpfulness and integration with students (where 1 = Strongly disagree and 4 = Strongly agree). Example items: "The teacher shows an interest in every student's learning", "The teacher gives extra help when students need it", "The enthusiasm of the teacher inspired me".
3. *Students' self-assessed academic competence.* This was assessed by a 14-item scale of students' reading ability and interest in books (where response 1 = Strongly disagree and 4 = Strongly agree). Example items: "I am able to understand difficult texts", "Reading is one of my favourite hobbies".
4. *Parental support.* This was measured by a three-item scale (where 1 = Strongly disagree and 4 = Strongly agree). Example item: "My parents support my educational efforts and achievements".
5. *School motivation.* This was measured by a six-item scale (response 1 = Strongly disagree and 4 = Strongly agree). Example item: "I feel like I belong at school".
6. *Self-esteem.* This was measured by a five-item scale (where 1 = Strongly disagree and 4 = Strongly agree). Example item: "I feel proud that I have accomplished things".
7. *Self-determination.* This was measured by a seven-item scale (where response 1 = Strongly disagree and 4 = Strongly agree). Example item: "Once I start a task, I persist until it is finished", "Part of the enjoyment I get from doing things is when I improve on my past performance".
8. *Meaning in life.* This was measured by a three-item scale (response 1 = Strongly disagree and 4 = Strongly agree). Example item: "My life has clear meaning or purpose".
9. *PISA scores in Reading, Math, and Science* (each consists of 10 items). The total PISA scores have been converted into equivalent IQ scores for each country as well as individual students.

The Cronbach's Alpha for the seven scales (2 to 8) ranged from 0.78 to 0.89, which is considered psychometrically acceptable.

7. Results

First, we examined the means (*M*) and standard deviations (*SD*) of the PISA 2018 scores, the equivalent IQ scores, parental education, and a set of psychological measures used in the study by country. These results are in the appendix. Second, a correlation analysis was conducted with the variables used in the study; results are exhibited in Table 1.

Table 1 shows the correlations, nearly all of which were significant given the very large *N*. The average PISA scores significantly correlated with parental education, teachers' attitudes in teaching and learning in schools, students' academic confidence in reading, parental support, school motivation, self-esteem and self-determination ($r = 0.05$ to $r = 0.36$; $p < .001$). The was a gender effect, in which female students scored slightly higher than male students on the total scores of PISA 2018 ($r = 0.05$, $p < .001$). A further examination of this association shows that the correlation between gender and Reading scores was $r = 0.14$ ($p < .001$), Maths scores $r = -0.02$ ($p < .001$), and Science scores $r = 0.02$ ($p < .001$).

Following this, two models of regression analyses were conducted (see Table 2). In Model 1, gender and parental education were entered into the equation, accounting for 8 % of the variance. In Model 2, a set of psychological variables were entered into the equation, accounting for an additional 16 % of the variance. In total, six psychological variables, maternal and paternal education, students' academic confidence in

Table 1
Correlation matrix for variables in the study by individual students.

Measures	Mean *SD*	IQ 2018 (PISA)	Gender	Maternal education	Paternal education	Teachers' attitudes	Students' academic competence in reading	Parental support	School motivation	Self-esteem	Self-determination
IQ 2018 (PISA)	93.57 (14.75)	_									
Gender	0.50 (0.50)	0.05***	_								
Maternal education	4.12 (1.11)	0.29***	−0.01	_							
Paternal education	4.08 (1.10)	0.28***	0.01	0.56***	_						
Attitude to Teachers	38.50 (8.35)	0.05***	0.04***	−0.02*	0.02*	_					
Students' academic SE-competence	38.34 (5.91)	0.36***	0.18***	0.11***	0.12***	0.19***	_				
Parental support	9.81 (2.17)	0.17***	0.08***	0.07***	0.07***	0.23***	0.16***	_			
School motivation	9.27 (2.16)	0.15***	0.01	0.08***	0.07***	0.16***	0.12***	0.28***	_		
Self-esteem	15.0 (2.62)	0.07***	−0.02*	0.04***	0.04***	0.25***	0.20***	0.19***	0.47***	_	
Self-determination	20.56 (3.78)	0.08***	−0.04***	0.02*	0.03**	0.26***	0.17***	0.22***	0.45***	0.38***	_

The analysis was weighted with country weight. Numbers ranged from $n = 460{,}283$ to $n = 581{,}740$.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 2
Predicting PISA total scores in 2018 by individual students.

Measures	Model 1		Model 2		
	Beta	*t*	Beta	*t*	*p*[†]
Gender	0.03	9.14***	0.01	1.43	0.147
Maternal education	0.18	74.29***	0.16	71.42***	<0.001
Paternal education	0.15	61.86***	0.12	54.46***	<0.001
Attitude to Teachers			0.01	1.74	<0.001
Students' academic SE competence			0.36	186.73***	<0.001
Parental support			0.06	27.08***	<0.001
School motivation			0.07	36.26***	<0.001
Self-esteem			0.01	1.13	0.257
Self-determination			0.04	15.04***	<0.001
Variance explained	*R^2 adjusted = 0.079* *F = 6758.04***		*R^2 adjusted = 0.244* *F = 7593.39****		

SE = Self-estimated.
*** $p < .001$.
† Significance levels in the final model. The analyses were weighted with country weight.

reading, school motivation, and self-determination were all significant predictors of average PISA scores in 2018, accounting for 24 % of the variance. The strongest predictor of the average IQ scores in 2018 was academic confidence in reading ($\beta = 0.36$, $p < .001$), followed by maternal education ($\beta = 0.16$, $p < .001$).

8. Discussion

Perhaps the most fascinating results are to be seen in the regression. It revealed that the strongest determinant of the PISA score was the student's self-assessed academic confidence. Indeed, this is to be expected given the numerous studies on the relationship between IQ tests and self-estimates/assessments of scores (Freund & Kasten, 2012; Furnham & Grover, 2020; Furnham & Robinson, 2023). By adolescence, most students have enough comparative data and feedback to know their IQ, though estimates are affected by a number of factors like gender, personality and test-taking experience. In this study, they did not estimate their IQ but, instead, completed a measure of self-perceived academic competence. This medium-sized correlation was surprisingly high ($r = 0.36$, $p < .001$). In short, 15 years olds have, not unsurprisingly, insight into their abilities.

The regression further indicated the role played by parents in terms of biology and socialization. Four things are noticeable from the parental data. *First,* the highest correlation was between the educational level of both parents, which implies some form of assortative mating. *Second*, correlations suggest that the relationship between the child's PISA score and both parent's education was very similar, though the correlation indicates that maternal scores were stronger predictors. *Third,* parental education was linked to both their children's self-perceived competence and their overall self-esteem. It is probable that both genetic and socialization factors play a role here; parental IQ partially determines their children's IQ and their own education, which impacts how they socialize their children. Many quote philosophers saying, "Choose your parents wisely" as they impact on so many features of one's life. *Fourth,* parental education related considerably more with children's PISA scores than perceived parental support, though the latter produced a significant association. However, perceived parental support related much more to their children's motivation, determination and self-esteem. Clearly parents who are encouraging and very interested in their children's academic development have the desired impact on them.

The correlational and regression results differed for children's ratings of general self-esteem and self-determination. The correlational results demonstrate that they were similarly related to the PISA scores, while the regression portrayed the latter as relating more to the PISA scores. Self-determination in this data set seems to be related to achievement motivation, as well as general Conscientiousness, which has been extensively studied and linked to a number of important life outcomes.

Interestingly, the pupil's perceptions of their teachers were little related to their PISA scores. Numerous reasons offer an explanation for this; teacher evaluation is a function of many things, including pupil's personality, students usually have many teachers whom they rate very differently, and students' IQ is relatively unrelated to teaching quality.

Perhaps the most intriguing result of the study, as depicted in the regression, was the factors which *did not* relate to the PISA score, including attitude toward the teacher and self-esteem. It is possible however, that the variance accounted for by self-esteem appeared non-significant because this factor is so closely related to self-determination.

Three parental factors were highly significant in the regression. Both parents' education, particularly maternal educational level, was influential in predicting the PISA score. There are different ways to interpret this; brighter parents had children with higher scores because they passed on their IQ biologically, alongside their values regarding education. Education is closely linked with occupation, which is usually taken as a proxy for social class, hence the discovery that higher social class students do better in school, partly due to their received support and encouragement. The question for both sociologists and psychologist is to explain precisely why and how parental education levels are so closely related to the academic success of their children.

As a reviewer of this paper noted among the variables analyzed, only mother's and father's education are the actual causes of intelligence. Further as the student's PISA scores are an indicator of their intelligence, so parents' education is an indicator of their intelligence. The correlation between parental education and student's intelligence reveals essentially the strong heritability of intelligence. An individual's intelligence is agreed to be more or less set around age 11 yrs., so by age 15 yrs., the PISA respondents have attained their adult intelligence which has a heritability of about 0.80. Parental education could be seen as the proxy for the genetic effects on intelligence.

It is noteworthy that self-assessed academic confidence was the strongest predictor of the PISA score: that is, those who believed they were academic talented (clever, high IQ) did best in exams, which we a form of IQ test. This confirms the many studies concerning the relationship between self-estimated and test-derived IQ scores, which suggest a medium-sized correlation between $0.20 < r < 0.40$ (Furnham & Grover, 2020). In short, by mid-adolescence, young people have a good idea of how bright they are. However, it would be particularly interesting to study outliers: those which high self-confidence and relatively low PISA scores and those with low self-confidence and high PISA scores. The literature suggests a major sex difference between these two groups.

However, it is meaningful that whilst there was a small gender effect in the final regression, gender was not significant. The topic of sex differences in intelligence remains very controversial (Eagly & Revelle, 2022), with evidence suggesting small and specific differences and female advantage over males in mid-adolescence.

9. Limitations

Having access to this large data set provides many research opportunities, however, it brings a number of limitations, primarily concerning what was not assessed/measured and how variables were measured. Although the assessments were internally reliable, many variables were measured using short, unidimensional items rather than recognized and validated tests. The latter were presumably not used because of their length. Several other, possibly mediating, moderating and confounding factors were not assessed, such as the type/size of school students attended and the actual competence and experience of the teachers. Third, all variables were based on self-reports with obvious limitations associated with method invariance and impression

management, namely the inconsistency of introspection. Nevertheless, the size of the *N* and the general quality of the data assessed suggest that the results are robust.

Further, in this study we did not use country as a dummy variable which may have accounted for specific variance though we believe this to be small. Also, we separated maternal and paternal education, as we had both available though they were highly correlated and they may have taken some variance from one another possibly leading to an underestimation of the parental effect.

Ethics approval

UCL Psychology Dept number CEHP/514.2013 granted permission for this study to be done,

CRediT authorship contribution statement

AF: Conceptualisation, paper writing, resources.
HC: Data curation and analysis.

Registration

This paper was not pre-registered with the journal.

Ethics

This was sought and obtained (CEHP/514/2017).

Informed consent

Participants gave consent for their anonymised data to be analyzed and published.

Declaration of competing interest

There is no conflict of interest in this research or paper.

Data availability

The authors do not have permission to share data.

Appendix A

PISA scores on Reading, Math, Science, the equivalent IQ scores from the PISA average scores in 2018, and a set of psychological measures by country.

	Country		PISA 2018 Score			PISA total Mean (SD)	IQ [a] 2018 Mean (SD)	Teachers' attitudes	Students' academic competence in reading	Parental support	School motivation	Self-esteem	Self-determination
		N	Read	Math	Science								
1	Albania	6359	405.4	437.2	416.7	419.8 (68.76)	88.0 (10.31)	45.31 (7.43)	40.60 (5.37)	10.39 (1.86)	10.24 (2.04)	16.40 (2.49)	22.97 (3.71)
2	Baku (Azerbaijan)	6827	389.4	419.6	397.6	402.2 (69.06)	85.3 (10.36)	40.26 (9.07)	39.0 (5.16)	9.50 (2.58)	8.84 (2.52)	15.62 (3.26)	20.96 (5.01)
3	Argentina	11,975	401.5	379.5	404.1	395.0 (79.73)	84.3 (11.96)	37.70 (8.04)	36.50 (6.05)	9.65 (2.31)	9.18 (2.15)	14.94 (2.73)	20.53 (3.68)
4	Australia	14,273	502.6	491.4	503.0	499.0 (91.86)	99.8 (13.77)	39.42 (8.46)	38.32 (6.79)	10.22 (2.04)	8.94 (2.17)	15.02 (2.47)	20.29 (3.45)
5	Austria	6802	484.4	498.9	489.8	491.0 (98.39)	98.7 (13.41)	36.02 (8.95)	39.11 (6.61)	10.11 (2.22)	10.14 (2.27)	15.11 (2.74)	19.82 (3.91)
6	Belgium	8475	492.9	508.1	498.8	499.9 (92.07)	100.0 (13.81)	36.37 (7.71)	36.25 (6.36)	9.89 (1.95)	9.78 (1.94)	14.46 (2.18)	18.75 (3.03)
7	Bosnia and Herzegovina	6480	403.0	406.4	398.5	402.6 (71.10)	85.4 (10.66)	37.35 (8.39)	38.30 (5.74)	9.90 (2.16)	9.37 (2.17)	15.59 (2.67)	20.57 (3.91)
8	Brazil	10,691	412.9	383.6	403.6	400.0 (84.64)	85.0 (13.00)	37.92 (8.13)	38.47 (5.48)	9.65 (2.12)	8.93 (2.19)	14.51 (2.57)	20.66 (3.52)
9	Brunei Darussalam	6828	408.1	430.1	431.0	423.1 (89.24)	88.5 (13.49)	38.58 (6.01)	36.21 (5.33)	9.78 (2.02)	8.46 (1.93)	14.53 (2.15)	21.28 (3.13)
10	Bulgaria	5294	419.8	436.0	424.1	426.7 (88.70)	89.0 (13.30)	40.49 (7.81)	39.12 (5.11)	9.85 (1.94)	9.57 (2.03)	14.41 (2.16)	20.18 (3.29)
11	Belarus	5803	473.8	471.9	471.3	472.3 (82.19)	95.8 (12.33)	40.49 (7.81)	39.12 (5.11)	9.85 (1.94)	9.57 (2.03)	14.41 (2.16)	20.18 (3.29)
12	Canada	22,653	520.1	512.0	518.0	516.7 (85.45)	102.5 (12.82)	–	39.21 (6.59)	–	8.95 (2.19)	15.28 (2.54)	20.68 (3.63)
13	Chile	7621	452.3	417.4	443.6	437.8 (77.84)	90.7 (11.68)	40.10 (8.47)	37.36 (6.21)	9.96 (2.39)	9.23 (2.22)	15.63 (2.81)	21.04 (3.81)
14	China (B-S-J-Z)	12,058	555.2	591.4	590.5	579.0 (75.85)	111.9 (11.38)	41.50 (8.44)	41.19 (5.37)	9.95 (1.89)	9.15 (1.89)	14.63 (2.37)	21.79 (3.17)
15	Colombia	7522	412.3	390.9	413.3	405.5 (75.77)	85.8 (11.37)	39.52 (7.63)	37.98 (5.16)	9.80 (2.17)	9.03 (2.06)	15.70 (2.43)	21.07 (3.68)
16	Costa Rica	7221	426.5	402.3	415.6	414.8 (68.39)	87.2 (10.26)	39.33 (8.47)	37.22 (6.14)	10.35 (2.30)	9.43 (2.19)	16.09 (2.54)	22.13 (4.12)
17	Croatia	6609	479.0	464.2	472.4	471.9 (80.18)	95.8 (12.03)	37.72 (8.55)	37.32 (5.73)	10.03 (2.05)	9.63 (2.06)	15.58 (2.36)	20.42 (3.45)
18	Czech Republic	7019	490.2	499.5	496.8	495.5 (86.88)	99.3 (13.03)	34.45 (7.98)	37.22 (6.29)	9.26 (1.95)	8.94 (1.92)	14.24 (2.38)	19.31 (3.49)
19	Denmark	7657	501.1	509.4	492.6	501.1 (80.58)	100.2 (12.09)	39.46 (7.34)	38.61 (5.55)	10.17 (1.90)	10.03 (2.00)	15.11 (2.32)	20.14 (3.35)

(*continued on next page*)

(*continued*)

	Country		PISA 2018 Score			PISA total Mean (SD)	IQ [a] 2018 Mean (SD)	Teachers' attitudes	Students' academic competence in reading	Parental support	School motivation	Self-esteem	Self-determination
		N	Read	Math	Science								
20	Dominican Republic	5674	341.6	325.1	335.6	334.1 (66.57)	75.1 (9.99)	39.80 (8.19)	38.82 (5.21)	9.33 (2.58)	8.55 (2.44)	15.71 (3.11)	20.75 (4.68)
21	Estonia	5316	523.0	523.4	530.1	525.5 (79.54)	103.8 (11.93)	36.32 (7.98)	38.75 (5.65)	9.52 (2.16)	9.37 (1.96)	14.88 (2.46)	19.32 (3.31)
22	Finland	5649	520.1	507.3	521.9	516.4 (84.83)	102.5 (12.72)	38.40 (6.38)	38.40 (6.38)	38.40 (6.38)	9.56 (2.12)	14.88 (2.47)	19.35 (3.63)
23	France	6308	492.6	495.4	493.0	494.0 (89.42)	99.1 (13.41)	36.19 (8.72)	37.32 (7.12)	10.00 (2.12)	9.34 (1.87)	14.70 (2.61)	19.28 (3.74)
24	Georgia	5572	379.8	397.6	382.7	386.7 (75.42)	83.0 (11.31)	38.88 (8.51)	39.65 (5.22)	9.84 (2.01)	9.51 (2.25)	14.82 (2.85)	20.70 (4.05)
25	Germany	5451	498.3	500.0	503.0	500.4 (94.28)	100.1 (14.14)	36.30 (8.27)	38.62 (6.58)	9.98 (2.24)	10.17 (2.07)	14.88 (2.55)	19.68 (3.69)
26	Greece	6403	457.4	451.4	451.6	453.5 (81.64)	93.0 (12.25)	36.78 (8.15)	38.78 (5.44)	9.83 (2.10)	9.52 (2.05)	15.19 (2.44)	20.83 (3.46)
27	Hungary	5132	476.0	481.1	480.9	479.3 (87.25)	96.9 (13.09)	37.53 (8.59)	38.93 (6.24)	9.92 (2.04)	9.64 (2.09)	15.42 (2.35)	20.3 (3.48)
28	Iceland	3296	474.0	495.2	475.0	481.4 (87.08)	97.2 (13.06)	37.46 (8.34)	37.53 (6.79)	10.53 (2.15)	9.53 (2.47)	15.12 (2.97)	19.82 (4.25)
29	Indonesia	12,098	371.0	378.7	396.1	381.9 (66.04)	82.3 (9.91)	40.42 (6.64)	37.36 (4.02)	9.96 (2.23)	9.20 (1.98)	14.90 (2.23)	21.10 (3.48)
30	Ireland	5577	518.1	499.6	496.1	504.6 (78.59)	100.7 (11.79)	38.36 (8.02)	38.46 (6.76)	10.28 (1.99)	9.18 (2.01)	14.88 (2.25)	20.22 (3.27)
31	Israel	6623	470.4	463.0	462.2	465.2 (105.8)	94.8 (15.87)	36.89 (9.18)	39.25 (6.34)	–	–	15.31 (2.94)	21.17 (4.08)
32	Italy	11,785	476.3	486.6	468.0	477.0 (85.23)	96.5 (12.78)	36.23 (8.01)	38.70 (6.31)	9.53 (2.18)	9.82 (2.0)	14.87 (2.48)	21.45 (3.66)
33	Kosovo	5058	353.1	365.9	364.9	361.3 (62.25)	79.2 (9.33)	41.10 (7.44)	41.08 (4.88)	10.16 (2.07)	9.58 (2.06)	15.77 (2.50)	21.65 (3.62)
34	Japan	6109	503.9	527.0	529.1	520.0 (84.31)	103.0 (12.65)	36.0 (8.13)	37.43 (6.85)	9.34 (2.31)	9.64 (1.94)	13.11 (2.82)	19.14 (4.20)
35	Kazakhstan	19,507	386.9	423.1	397.1	402.4 (67.99)	85.4 (10.20)	41.54 (7.62)	39.05 (4.58)	9.56 (2.36)	9.02 (2.19)	14.58 (2.61)	19.44 (4.15)
36	Jordan	8963	419.1	399.8	429.3	416.0 (75.38)	87.4 (11.31)	41.32 (9.27)	38.91 (4.85)	9.53 (2.51)	8.83 (2.27)	15.53 (3.05)	22.04 (4.45)
37	Korea	6650	514.1	525.9	519.0	519.7 (90.99)	102.9 (13.65)	41.11 (8.58)	38.47 (5.89)	10.18 (1.81)	10.14 (1.92)	14.80 (2.59)	20.95 (3.38)
38	Lebanon	5614	353.4	393.5	383.7	376.8 (92.92)	81.5 (13.94)	–	–	9.65 (2.17)	–	14.40 (3.26)	20.88 (4.24)
39	Latvia	5303	478.7	496.1	487.3	487.3 (76.07)	98.1 (11.41)	37.37 (7.46)	38.08 (5.46)	9.20 (2.39)	8.98 (2.10)	14.46 (2.35)	19.88 (3.60)
40	Lithuania	6885	475.9	481.2	482.1	479.7 (84.15)	97.0 (12.62)	38.05 (8.67)	39.33 (5.77)	9.92 (2.30)	9.27 (2.68)	15.52 (2.65)	20.18 (3.93)
41	Luxembourg	5230	470.0	483.4	476.8	476.7 (94.26)	96.5 (14.14)	36.26 (8.74)	38.41 (6.48)	9.74 (2.22)	9.73 (2.19)	14.89 (2.81)	19.15 (4.0)
42	Malaysia	6111						40.18 (6.50)	37.26 (4.66)	9.88 (1.92)	9.16 (1.87)	14.14 (2.15)	22.13 (3.23)
43	Malta	3363	448.2	471.7	456.6	458.8 (99.30)	93.8 (14.90)	39.19 (8.94)	39.30 (6.22)	10.17 (2.15)	8.93 (2.16)	15.19 (2.60)	21.33 (3.70)
44	Mexico	7299	420.5	408.8	419.2	416.2 (70.93)	87.4 (10.64)	39.12 (7.85)	38.35 (5.26)	10.03 (2.30)	9.36 (2.21)	15.84 (2.48)	21.48 (4.02)
45	Moldova	5367	424.0	420.6	428.5	424.4 (81.76)	88.7 (12.26)	41.46 (7.04)	38.57 (5.34)	9.86 (1.85)	9.33 (1.94)	15.14 (2.21)	20.75 (3.13)
46	Montenegro	6666	421.1	429.6	415.2	421.9 (75.02)	88.3 (11.25)	38.80 (8.99)	39.85 (5.74)	9.91 (2.17)	9.36 (2.23)	15.86 (2.74)	20.38 (3.95)
47	Morocco	6814	359.4	367.7	376.6	367.9 (63.83)	80.2 (9.57)	37.28 (8.29)	37.83 (4.35)	9.0 (2.32)	8.69 (2.10)	15.05 (2.71)	21.64 (3.78)
48	Netherlands	4765	484.8	519.2	503.4	502.5 (93.77)	100.4 (14.07)	35.83 (7.43)	36.59 (6.25)	10.11 (1.85)	10.15 (1.84)	14.70 (2.21)	19.02 (3.17)
49	New Zealand	6173	505.7	494.5	508.5	502.9 (92.25)	100.4 (13.83)	39.58 (8.21)	38.04 (6.80)	10.29 (2.04)	8.97 (2.06)	14.93 (2.33)	20.22 (3.44)
50	Norway	5813	499.5	501.0	490.4	496.9 (90.07)	99.5 (13.51)	37.19 (8.46)	36.80 (6.25)	10.26 (2.09)	10.05 (2.21)	–	20.15 (3.88)
51	Panama	6270	377.0	352.8	364.6	364.8 (76.08)	79.7 (11.41)	39.80 (7.94)	37.85 (5.41)	9.74 (2.44)	8.82 (2.26)	15.94 (2.74)	21.53 (4.15)
52	Peru	6086	400.5	399.8	404.2	401.5 (77.63)	85.2 (11.64)	40.34 (7.24)	38.57 (4.89)	9.69 (2.17)	9.37 (2.03)	15.63 (2.33)	21.83 (3.81)
53	Philippines	7233	339.7	352.6	357.0	349.7 (77.11)	77.5 (10.67)	40.71 (7.19)	36.86 (4.48)	9.72 (2.30)	8.70 (2.09)	15.0 (2.44)	20.60 (3.67)
54	Poland	5625	511.9	515.6	511.0	512.8 (84.59)	101.9 (12.69)	36.54 (8.43)	38.57 (6.02)	9.14 (2.29)	9.05 (2.17)	14.82 (2.47)	20.21 (3.30)

(*continued on next page*)

(*continued*)

	Country		PISA 2018 Score			PISA total Mean (SD)	IQ [a] 2018 Mean (SD)	Teachers' attitudes	Students' academic competence in reading	Parental support	School motivation	Self-esteem	Self-determination
		N	Read	Math	Science								
55	Portugal	5932	491.8	492.5	491.7	492.0 (87.32)	98.8 (13.10)	38.62 (8.14)	38.26 (5.99)	10.44 (1.79)	9.75 (1.91)	14.96 (2.29)	20.51 (3.18)
56	Qatar	13,828	407.1	414.2	419.1	413.5 (94.91)	87.0 (14.24)	38.20 (9.09)	38.46 (5.71)	9.8 (2.40)	8.93 (2.29)	15.09 (2.86)	21.48 (4.41)
57	Romania	5075	427.7	429.9	425.8	427.8 (85.07)	89.2 (12.76)	39.66 (7.99)	38.13 (5.66)	9.95 (2.0)	9.46 (2.02)	15.34 (2.34)	21.04 (3.45)
58	Russian Federation	7608	478.5	487.8	477.7	481.3 (78.45)	97.2 (11.77)	38.74 (8.11)	39.43 (5.38)	9.15 (2.22)	8.57 (2.11)	14.09 (2.54)	19.58 (3.53)
59	Saudi Arabia	6136	399.2	373.2	386.2	386.2 (70.99)	82.9 (10.65)	39.67 (8.76)	38.43 (5.15)	9.78 (2.39)	9.44 (2.30)	15.57 (3.08)	21.48 (4.199)
60	Serbia	6609	439.5	448.3	439.9	442.5 (85.35)	91.4 (12.80)	38.08 (8.88)	38.80 (5.75)	9.66 (2.27)	9.37 (2.24)	15.80 (2.86)	19.76 (3.75)
61	Singapore	6676	549.5	569.0	550.9	556.5 (91.70)	108.5 (13.76)	39.82 (7.92)	38.12 (6.64)	9.86 (2.09)	9.05 (2.08)	15.11 (2.29)	21.13 (3.17)
62	Slovak Republic	5965	495.3	508.9	507.0	503.7 (82.29)	100.6 (12.34)	35.32 (7.82)	37.60 (6.02)	9.34 (2.35)	8.86 (2.20)	14.18 (2.65)	19.59 (3.52)
63	Slovenia	6401						35.54 (8.34)	37.85 (5.90)	9.87 (2.07)	9.35 (2.03)	14.82 (2.51)	20.52 (3.30)
64	Spain	35,943	–	481.4	483.3	482.5 (81.20)	97.4 (12.18)	36.24 (8.68)	38.72 (6.42)	9.96 (2.22)	10.27 (2.07)	15.40 (2.55)	20.97 (3.46)
65	Sweden	5504	505.8	502.4	499.4	502.5 (90.78)	100.4 (13.62)	38.16 (8.47)	37.70 (6.33)	9.92 (2.08)	9.52 (2.27)	14.74 (2.73)	19.33 (3.75)
66	Switzerland	5822	483.9	515.3	495.3	498.2 (90.06)	99.7 (13.51)	37.48 (8.43)	37.76 (6.65)	10.12 (2.18)	10.06 (2.07)	15.02 (2.48)	19.14 (3.70)
67	Thailand	8633	392.9	418.6	425.8	412.4 (73.12)	86.9 (10.97)	40.74 (6.82)	35.71 (4.36)	9.74 (1.76)	8.58 (1.91)	15.07 (2.10)	20.93 (3.10)
68	United Arab Emirates	19,277	431.8	434.9	433.6	433.5 (98.03)	90.0 (14.70)	40.51 (9.14)	38.98 (5.90)	10.01 (2.42)	9.14 (2.26)	15.67 (2.87)	21.97 (4.22)
69	Turkey	6890	465.6	453.5	468.3	462.5 (79.20)	94.4 (11.88)	37.15 (8.73)	40.64 (5.62)	9.89 (2.39)	9.06 (2.36)	15.76 (2.88)	20.52 (4.39)
70	Ukraine	5998	466.0	453.1	469.0	462.7 (84.32)	94.4 (12.65)	37.25 (7.06)	39.37 (5.06)	9.64 (2.12)	8.97 (2.01)	14.92 (2.28)	19.46 (3.24)
71	North Macedonia	5569	392.7	394.4	413.0	400.0 (82.16)	85.0 (12.32)	–	–	10.49 (1.74)	–	16.07 (2.76)	22.51 (3.80)
72	United Kingdom	13,818	503.9	501.8	504.7	503.5 (88.43)	100.5 (13.26)	39.52 (8.27)	37.97 (6.69)	10.05 (2.15)	9.07 (2.10)	14.48 (2.54)	19.97 (3.52)
73	United States	4838	505.4	478.2	502.4	495.3 (92.67)	99.23 (13.90)	39.23 (8.20)	38.44 (6.48)	10.09 (2.15)	8.74 (2.21)	15.38 (2.47)	21.03 (3.63)
74	Uruguay	5263	427.1	417.7	425.8	423.5 (81.59)	88.5 (12.24)	37.82 (7.86)	38.29 (6.14)	9.89 (2.35)	9.20 (2.14)	15.29 (2.72)	20.47 (3.98)

Note: Observations (N) were unweighted, means and standard deviations (SD) weighted with Senate Weight (country weight).

[a] Equivalent IQ score from the PISA average score in 2018. B-S-J-Z = Beijing, Shanghai, Jiangsu, and Zhejiang.

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