



PISA FOR DEVELOPMENT

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What does PISA data tell us about education in middle-income countries?

This chapter reviews the evidence regarding the quality and equity of education in middle-income countries, as shown through the Programme for International Student Assessment (PISA) 2012 assessment of mathematics. The first section documents the extent of educational quality and inequality in the mathematics performance of students in 18 middle-income countries that participated in PISA 2012, as presented in OECD publications. The second section reviews the empirical evidence for systemic institutional factors (accountability, autonomy, competition, tracking and preschool) that are related to higher levels of performance, generally, and as they are related to performance in the 18 countries participating in PISA 2012. It also examines school factors (school inputs, teacher quality, and instructional time) generally related to student performance in low- and middle-income countries and in the 18 middle-income countries participating in PISA 2012. The third section reports the results from new multi-level analyses and other statistical approaches undertaken for this chapter that further explore these topics.

INTRODUCTION

Successful education systems simultaneously achieve high levels of student achievement and an equitable distribution of achievement across all students, without regard to the immutable characteristics of their school (such as its geographical location) or of the student themselves (such as their social background, gender, ethnicity or home language). How educational systems become successful has been greatly debated over the past half century, and cross-country studies have been undertaken to shed light on this issue. As Foshay noted in 1962: “If custom and law define what is educationally allowable within a nation, the educational systems beyond one’s national boundaries suggest what is educationally possible” (Hanushek and Wößmann, 2014).

“What is possible” includes systemic possibilities as well as school, classroom and teacher possibilities. These have all been explored extensively across the typically high-income countries/economies that have participated in international large-scale assessments in the 1970s, 1980s, 1990s and early 2000s. They have also been explored to a lesser extent in regional large-scale assessments. Countries that have performed less well on these assessments have often turned to higher performing countries/economies for advice. But the growing number of middle-income countries participating in international large-scale assessments raises the question of how much the experience of higher-income countries can be generalised across these new boundaries. The purpose of this chapter is to explore this issue.

The most recent PISA reports from PISA 2012 provide a massive amount of information – over 2 000 pages of text and data – regarding the education systems that participated in the assessment. This chapter draws, in part, from four volumes:

1. *PISA 2012 Results Volume I: What Students Know and Can Do: Student Performance in Mathematics, Reading and Science* (OECD, 2014).
2. *PISA 2012 Results Volume II: Excellence through Equity: Giving Every Student the Chance to Succeed* (OECD, 2013a).
3. *PISA 2012 Results Volume III: Ready to Learn: Students’ Engagement, Drive and Self-Beliefs* (OECD, 2013b).
4. *PISA 2012 Results Volume IV: What Makes Schools Successful? Resources, Policies and Practices* (OECD, 2013c).

It is beyond the scope of this chapter to summarise all the analyses in these volumes, but in the sections below some key findings relevant to middle-income countries are reported. In particular, issues of equality in opportunity linked to students’ socio-economic background are explored at length.

This chapter is organised as follows. First, it documents the extent of educational quality and inequality in middle-income countries, with particular reference to the mathematics performance of students in 18 middle-income countries that participated in PISA 2012.¹ Then, it reviews the empirical evidence for systemic and school (including classroom and teacher) factors that are associated with higher levels of performance in general, and with lower performance gaps between groups. This draws on recent literature and the OECD’s analysis of PISA 2012, with specific reference made to the 18 participating middle-income countries. Finally, it presents the results from original analyses of the data from these 18 countries that were carried out for this report.²

EDUCATIONAL QUALITY AND INEQUALITY IN MIDDLE-INCOME COUNTRIES

Quality is generally lower than in OECD countries

The overall quality of learning outcomes in low- and middle-income countries has been studied extensively in recent decades, drawing on various international large-scale assessments, regional large-scale assessments, and national assessments. The general finding is that the quality of learning outcomes in low- and middle-income countries, assessed at every level from primary school through to upper secondary school, is often very poor. However, variations in learning outcomes are large, and there exist well-performing low- and middle-income countries and well-performing schools within these countries.

The OECD analyses reported in the PISA 2012 volumes show that the overall performance of 15-year-old students in all of the middle-income countries participating in PISA 2012, other than Viet Nam, was lower than that of students in the OECD countries, and varies widely (Figure 6.1). Average mathematics scores in eight countries – Albania, Argentina, Brazil, Colombia, Indonesia, Jordan, Peru and Tunisia – fell below 400 points – compared with the OECD average of 494 points (OECD, 2013c).³

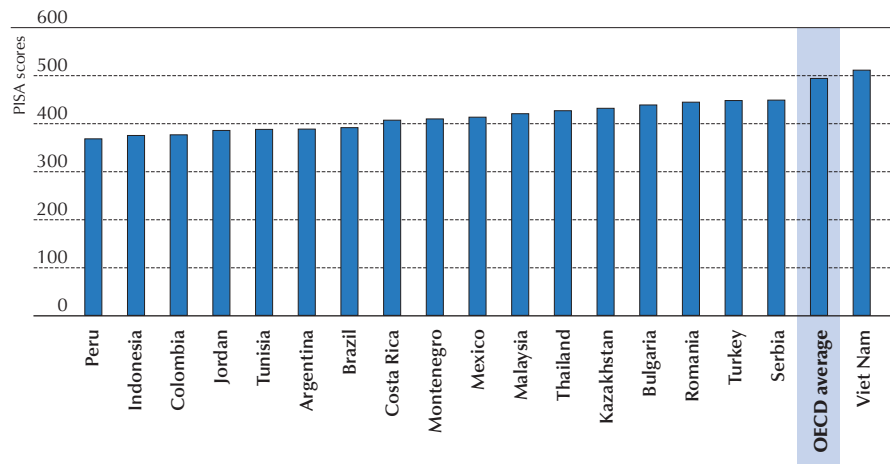
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The highest-performing country from this group was Viet Nam (511 points), which exceeded the OECD average by 17 points. Other relatively well-performing countries in the pool of below-average performers were: Bulgaria (439), Romania (445), Turkey (448), and Serbia (449). In most middle-income countries, performance in PISA has been steadily increasing over the past decade. The average annual improvement has been largest in Albania, Kazakhstan and Malaysia, at more than 5 points per year. Brazil, Bulgaria and Romania increased their annual performance by more than 4 points per year.

Figure 6.1

Average scores in mathematics in 18 low- and middle-income countries, PISA 2012

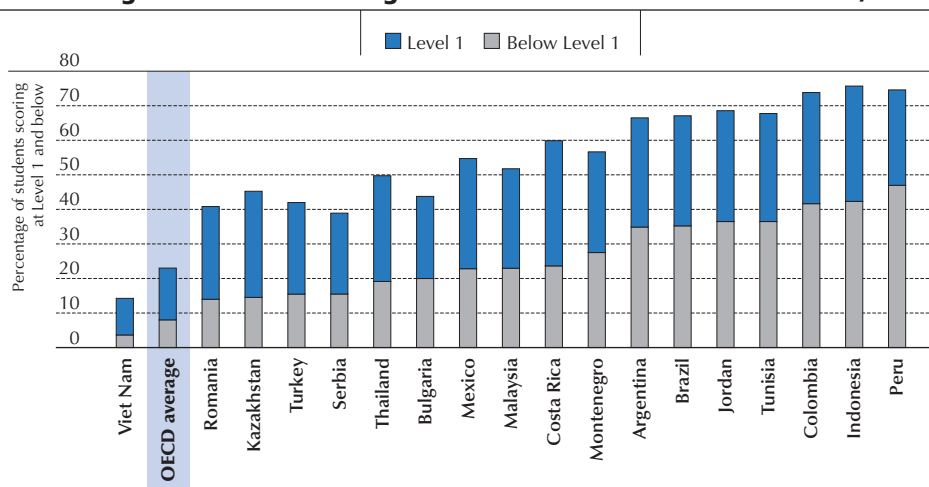


Source: OECD (2014), *PISA 2012 Results: What Students Know and Can Do (Volume I, Revised edition, February 2014): Student Performance in Mathematics, Reading and Science*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264208780-en>.

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Figure 6.2

Percentage of students scoring at level 1 and below in mathematics, PISA 2012



Source: OECD (2014), *PISA 2012 Results: What Students Know and Can Do (Volume I, Revised edition, February 2014): Student Performance in Mathematics, Reading and Science*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264208780-en>.

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PISA scores have been divided into six proficiency levels, from low proficiency (Level 1) to high proficiency (Level 6); a definition of each level is provided in Annex D. Low scores represent a concentration of students with low mathematics proficiency. Across OECD countries: 23% of students score at or below Level 1; 22.5% score at Level 2 (from 420 to less than 482); 23.7% score at Level 3 (from 482 to less than 544); 18.1% score at Level 4 (from 544 to less than 606); 9.3% score at Level 5 (from 606 to less than 669); and 3.3% score at Level 6 (above 669 points) (OECD, 2014).

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For more than half the participating middle-income countries, scores on the PISA mathematics test are concentrated at Level 1 or below (Figure 6.2). Approximately 75% of students in Colombia, Indonesia and Peru, and over 60% of students in Albania, Argentina, Brazil, Jordan and Tunisia, score at or below Level 1 in mathematics. In all of these countries only 1% of students are top performers, compared with 12.6% of students in OECD countries. This distribution of PISA scores in middle-income countries is addressed in a recent paper on the enhancement of PISA cognitive instruments (Adams and Cresswell, 2014).

One consequence of low PISA scores in many middle-income countries is a low variation in scores. Half of the middle-income countries in this study have the narrowest spread in student mathematics scores among all PISA participants; these countries are: Argentina, Brazil, Colombia, Costa Rica, Indonesia, Jordan, Kazakhstan, Tunisia and Thailand. Among the remaining nine countries where performance was higher, the variation in mathematics scores in Serbia and Turkey was close to the OECD average, while the variance in scores in Bulgaria exceeded the OECD average. Viet Nam is the only participating middle-income country that combines above-average PISA performance with below-average variation in performance.

Inequality is generally greater in middle-income countries than in OECD countries

Inequalities in educational outcomes are found in all countries and at all income levels. The sources of these inequalities differ from country to country, but they are often due to: the socio-economic background of the family (including parental education and occupational status), gender, ethnicity (including a disjoint between the language spoken at home and the language of school instruction) and school location (urban versus rural). These student and school background characteristics are frequently referred to as a “disadvantage”, and in many countries some children, often girls, face a “double disadvantage” when two or more of these disadvantages are combined (Lewis and Lockheed, 2007).

The specific characteristics of inequalities are likely to vary across countries. Table 6.1 describes some differences among the middle-income countries that participated in PISA 2012, with respect to several student and school characteristics.


— Table 6.1 —
Student characteristics, PISA 2012

	In rural schools (%)	Female (%)	Non-speaker of language of assessment (%)	In grade 7 or grade 8 (%)	Has repeated a grade (%)	Socio-economic status
OECD Average	9.4	--	10.6	5.4	12.4	0
Argentina	8.5	51.4	1.6	14	36.2	-0.72
Brazil	1.1	52.2	1.1	6.9	36.1	-1.17
Bulgaria	3.8	48.2	10.8	5.5	4.8	-0.28
Colombia	13.0	52.9	0.7	17.6	40.6	-1.26
Costa Rica	23.5	53.1	1.2	21.1	33.5	-0.98
Indonesia	29.1	49.2	58.9	10.2	15.5	-1.8
Jordan	10.4	50.6	4.7	1.2	7.9	-0.42
Kazakhstan	32.9	50.2	11.1	5.1	1.6	-0.32
Malaysia	13.4	51.6	42.3	0.1	0	-0.72
Mexico	15.1	51	3.2	6.3	15.5	-1.11
Montenegro	0	50	1	0.1	1.3	-0.25
Peru	18.8	51.4	6.4	10.5	27.5	-1.23
Romania	8.2	51	1.2	7.6	4.5	-0.47
Serbia	0.4	50.2	4.2	1.6	1.6	-0.3
Thailand	15.7	56	44.6	0.4	3.3	-1.35
Tunisia	4.4	53.4	1.1	16.8	38.7	-1.19
Turkey	2.3	49.5	6.2	2.7	14.4	-1.46
Viet Nam	45	--	2.2	3.1	7.7	-1.81

Sources: OECD (2014), *PISA 2012 Results: What Students Know and Can Do (Volume I, Revised edition, February 2014): Student Performance in Mathematics, Reading and Science*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264208780-en>.

OECD (2013a), *PISA 2012 Results: Excellence through Equity (Volume II): Giving Every Student the Chance to Succeed*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264201132-en>.

OECD (2013c), *PISA 2012 Results: What Makes Schools Successful (Volume IV): Resources, Policies and Practices*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264201156-en>.

StatLink  <http://dx.doi.org/10.1787/888933294069>



A higher share of students in middle-income countries attend schools in rural locations, defined by the OECD as “a village, hamlet or rural area with fewer than 3 000 people”, compared with students in OECD countries. In OECD countries, about 9% of students live in rural communities; this share is much larger in several middle-income countries. A slightly higher share of students in middle-income countries are female compared to OECD countries, but across all countries girls account for about half the students in the PISA assessment. Students who speak a home language that differs from the language of instruction – and, by inference, the language of the assessment, which is the measure of language differences used by PISA – are also more often found in middle-income countries than in OECD countries. In particular, the OECD average for students who do not speak the language of assessment at home is about 10%, whereas the share in some middle-income countries is several times higher: 59% in Indonesia, 45% in Thailand, and 42% in Malaysia.

In six countries the share of 15-year-olds in grades 7 or 8 is twice as high or greater than the OECD average. In Costa Rica, approximately 20% of 15-year-olds are in these grades. In part, this is due to the much higher rates of repetition, particularly in Latin American countries and Tunisia, where on average about one-third of students have repeated at least one year of schooling. It may also be due to a later school starting age in some countries.

The OECD uses an index of economic, social and cultural status, which comprises indicators such as parental education, parental occupation, cultural possessions in the home, educational resources in the home, and information and communication technology in the home. The index is calculated so that the OECD average is zero and the standard deviation is 1.0. The index values for all middle-income countries is below zero, ranging from 1.8 standard deviations below the OECD average in Viet Nam and Indonesia to 0.25 standard deviations below the OECD average in Montenegro. The value of this index varies widely within middle-income countries, with the socio-economic background of students in the lowest quartile of the index falling three standard deviations below the country average in some countries, and rising to one standard deviation above for students in the highest quartile of the socio-economic index in one country. In short, the students assessed by PISA in the middle-income countries differ substantially from those assessed in the OECD countries, and on average are more disadvantaged.

OECD ANALYSES OF CORRELATES OF PERFORMANCE

Multi-country international large-scale assessments can reveal differences among countries that are associated with variations in learning outcomes and have advantages over single-country studies (Hanushek and Wößmann, 2014). Since international large-scale assessments involve education systems with different institutional and school features, they provide a useful setting for understanding the link between variations in these features and educational outcomes. The OECD has conducted thorough analyses of the PISA 2012 data, only some of which is reported in this chapter. The OECD has examined: *i)* the quality and equity in the outcomes of PISA 2012, by country, in Volume II of the results from PISA 2012; *ii)* student attitudes and motivations in Volume III; and *iii)* various school-level correlates of student performance, by country, in Volume IV. This section reviews the correlates of performance at three levels: between-country correlates, between-school correlates within countries, and between-student correlates within schools and countries.

Systemic differences among countries

Much of the literature on the effects of systemic differences on student learning has focused on systemic differences among countries with respect to institutions and educational inputs.

Institutions and learning in OECD countries

A recent review article by Hanushek and Wößmann (2014) summarises the findings from 19 cross-country studies from the late 1990s and early 2000s, in which the majority of the countries were high-income economies. They identify five institutional features that differentiate the education systems among these high-income countries: accountability measures, school autonomy, competition and private involvement, early school tracking and the pre-primary education system. These features often create variations in educational incentive systems.

School accountability in the form of curriculum-based exit exams and regular standardised testing improves learning by increasing the reward of learning for students while incentivising stakeholders to monitor learning (Wößmann, 2003, 2005).

School autonomy is found to have positive effects on learning, but the positive impact from decentralised level decision makers, who have better access to information on best practices, only occurs if there is alignment between the incentives for schools and those for students (Fuchs and Wößmann, 2007).

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School competition, mostly in the form of competition between private and public schools, can improve the performance of both public and private schools under certain conditions (Wößmann, 2007). The advantage of private schools is higher in the countries where private schools receive large shares of public funding. This is assumed to be the consequence of a level playing field between private and public schools, through which competition and self-selection into these schools changes the mentality of the students, parents and the school staff.

Tracking is a way of placing students in schools and/or classes according to their past or anticipated performance (both academic and non-academic) and has been found to increase inequality (Wößmann, 2009). More homogenous classes may or may not help create optimal learning situations depending on the nature of the peer dynamics. While the optimisation of learning will take place through tailor-made curricula, tracking will, if implemented early on, disadvantage the weaker groups of students and increase the inequality of student achievement.

Pre-primary education enhances early learning and can potentially mitigate the effect of family background for disadvantaged children. Structural quality and the access to pre-primary education are positively related to both performance and greater equality of the educational systems (Berlinski, Galiani and Gertler, 2009; Engle et al., 2007; Schutz, Ursprung and Wößmann, 2008).

Inputs and learning in OECD countries

Educational systems differ in the amount and type of resources allocated to students at different levels, including resources such as per-student expenditure, quality of teachers and the amount of time for learning. Early research – with data primarily from high-income countries/economies – concluded that cross-national differences in educational expenditure and instructional time were generally unrelated to cross-national differences in performance in mathematics (Baker, Goesling and LeTendre, 2002; Hanushek, 1997). By comparison, one recent 46-country cross-national study on the effects of teacher quality, as measured by certification or degree, found a positive relationship to mathematics achievement across these countries (Akiba, LeTendre and Scribner, 2007). An analysis of PISA 2003 results in mathematics in 29 OECD countries concluded that expenditure per student, instructional time and teacher quality were all related to differences in achievement, but that the effects were small (Hanushek and Wößmann, 2014).

Differences between effects in OECD and middle-income countries

Can lessons derived from these analyses of systemic differences across high-income countries translate directly into advice for low- and middle-income countries? The answer is most likely “not automatically”. Most cross-country research does not disaggregate results according to the country’s economic status nor take into account associated differences in the cultural and socio-economic context between high-income and lower-income countries. Studies that examine growth in average student achievement, in particular, often fail to recognise that educational policy in low- and middle-income countries has focused on improving access (improving enrolment, attendance and school completion rates), stimulated by the education-related Millennium Development Goals (UNESCO, 2015). This has resulted in greater inclusiveness in the composition of the student population, but can also lower a country’s average performance, due to the higher share of disadvantaged students in the overall student population.

Some system-level institutions associated with improved performance in high-income countries/economies are associated with lower levels of performance in middle-income countries/economies. Using the PISA 2003 data, Hanushek, Link and Wößmann (2013) show that the impact of school autonomy on student achievement is highly heterogeneous and varies across countries and educational systems. At low levels of economic development, increased school autonomy – particularly in the decision-making areas related to instructional content, but also in the areas of personnel and budgeting – is associated with lower student outcomes. One reason for this may be the lack of interaction and co-operation between the overall institutional structures in developing countries and schools and their leadership. If the overall institutional structure is weak, the danger of decentralisation lies in the possibility that individual schools, often with weak leadership and little feedback regarding the consequences of decisions, pursue poorly chosen goals.

Similarly, the OECD (OECD, 2013c) shows that educational spending is not related to average performance at the country level across developed countries, yet this is definitely not the case for low- and middle-income countries, where the level of expenditure on education per students is very strongly correlated with educational performance. Hence, while money alone does not buy strong performance for developed countries, it certainly has very high returns in developing countries, where schooling systems are embedded in very different socio-economic realities. How the incentive structures guide the use of resources is seen as the most important determinant of educational outcomes for developed countries, but the lack of basic resources and the inequality of access to these resources is a key problem in low- and middle-income countries.



The OECD's analyses of the five features of education institutions (detailed above) identified by Hanushek and Wößmann (2014) provide support for the claim that accountability, autonomy, competition and tracking have little effect on student performance in middle-income countries, once the socio-economic background of students and the socio-economic composition of schools have been taken into account (Table 6.2). However, these institutional features are measured within countries and are based on school-level reports.

The OECD's within-country multi-level analyses show few positive associations between these institutional features and student performance in PISA 2012 mathematics in the participating middle-income countries, as summarised below and in Table 6.2:

- **Accountability systems** (external evaluation, student feedback and public posting of achievement results) are each related to student performance in two countries, with both positive and negative effects for external evaluation and public posting of results.
- **School autonomy** for resources is unrelated to performance in 16 countries and negatively related to performance in 2 countries, while autonomy for curriculum and assessment is positively related to performance in 2 countries.
- **Competition** is unrelated to student performance in all countries, but private schools have higher achievement in two countries and lower performance in two countries.
- **Ability grouping** is negatively related to performance in two countries whereas academic selection is positively related to performance in one country.
- **Preschool** (the percentage of students in a school who had attended) is positively associated with performance in six countries and negatively in one.

— Table 6.2 —

Institutional features and mathematics achievement in 18 middle-income countries, PISA 2012

Institutional features	PISA measure	Countries where feature has significant positive effect on mathematics achievement	Countries where feature has significant negative effect on mathematics achievement
Accountability	External evaluation: Administrative authority tracks data over time	Thailand	No countries
	Feedback from students	Colombia, Viet Nam	No countries
	Achievement data are posted publicly	Bulgaria	Mexico
Autonomy	Over resources	No countries	Bulgaria, Indonesia
	Over curriculum and assessment	Costa Rica, Thailand	
Competition	With other schools	No countries	No countries
	With private schools	Mexico, Viet Nam	Colombia, Indonesia
Tracking	Ability group in mathematics	No countries	Bulgaria, Turkey
	Academic selection	Turkey	No countries
Preschool	Percentage of students who attended pre-primary	Bulgaria, Malaysia, Mexico, Romania, Thailand, Viet Nam	Jordan

Note: Results are based on OECD's multilevel analysis and analyses control for socio-economic composition of the schools and socio-economic background of the students.

Source: OECD (2013c), *PISA 2012 Results: What Makes Schools Successful (Volume IV): Resources, Policies and Practices*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264201156-en> (Table IV.1.12c).

Differences among schools within countries

Unlike studies of systemic features, which have rarely looked specifically at low- or middle-income countries/economies, a great deal of literature on school features and their correlates with student performance within low- and middle-income countries has developed over the past several decades. This literature has been summarised in a number of recent reviews that address the quality of the research and the lessons learned (Glewwe et al., 2014; McEwan, 2014; Murnane and Ganimian, 2014). The conclusions from these reviews differ somewhat from conclusions reached in meta-analyses of "what works" in developed countries (Hattie, 2013; Wang, Haertel and Walberg, 1990), but are relatively consistent with the conclusions reached by Lockheed and Verspoor in an earlier review on school and family inputs (1990). Much of this research focuses on learning at the primary level, since until recently a very high share of secondary level age students had either still been in primary school or had been out-of-school altogether.



School inputs matter in many countries

In the late 1980s, Lockheed and Verspoor (1990) examined school inputs (curriculum, instructional materials, learning time and teaching quality) and family inputs (preschool experience and health and nutrition) as direct determinants of student learning in developing countries. Because randomised-control trials (RCTs) had been carried out for very few school inputs in few countries, most of the studies that were reviewed used cross-sectional correlational analyses, or “education production functions” (Fuller, 1987; Heyneman and Loxley, 1983; Lockheed and Hanushek, 1988; Simmons and Alexander, 1978). At the time it was widely thought that school inputs were more important than home background in developing countries, a departure from the evidence in developed countries. With the advent of new algorithms for analysing multi-level, hierarchically organised data, these conclusions about the relative importance of school and family background were called into question (Raudenbush and Willms, 1991; Riddell, 1989). During the 1990s, a range of new studies were carried out, often using multi-level analyses of cross-sectional data (Riddell, 2008).

Contemporary research identifies school inputs as important, but also acknowledges both the role of families and the broader institutional factors. Many recent reviews focus on studies that have used an experimental design (RCTs) to test their hypotheses, a sharp departure from the correlational analyses used in earlier research. Although RCTs are widely regarded as a “gold standard” for research methods, their use in evaluating school inputs has been limited to very few school inputs in low- or middle-income countries, and the conclusions from the few RCTs that have been carried out are inconsistent (Evans and Popova, 2015). Correlational analyses offer the opportunity to examine many additional school features.

Recent reviews of research on school inputs cover research using both correlational and experimental designs. In a review of 79 “good quality” studies, including 43 identified as “high quality” with respect to methodology, Glewwe et al. (2014) consider how physical school infrastructure and pedagogical supplies, characteristics of the principal and financial resources, contribute to student learning in developing countries, after the effects of student background has been statistically controlled. McEwan’s (2014) review of experiments examines school inputs (instructional inputs, teacher capacity, teacher effort, instructional time and health inputs) as well as parental inputs. Willms and Tramonte’s (2015) review adds to these inputs a child’s early learning opportunities, home and school language. Murnane and Ganimian (2014) draw greater attention to the teacher and teaching process. Evans and Popova (2015) observe that the overlap in studies examined in six reviews, including those of McEwan, Willms and Tramonte, and Murnane and Ganimian, is “surprisingly limited” with 75% of the studies occurring in only one of the reviews.

Despite the differences among these reviews and meta-analyses in terms of the types of research and the topics covered, some of the conclusions are remarkably similar:

- **Basic school inputs** – textbooks, desks and chairs, electricity, and even the quality of the school’s roof and walls – make a difference in many low- and lower-middle-income countries where such inputs are not widely available (Glewwe et al., 2014).
- **Teacher quality**, particularly subject matter knowledge and teaching practice, is consistently related to student learning in low- and middle-income countries (Glewwe et al., 2014; Kremer, Brannen and Glennerster, 2013; McEwan, 2014; Murnane and Ganimian, 2014) as well as in high-income countries (Hattie, 2013).
- **Instructional time** – greater when teacher absenteeism is lower – is also related to student learning in some countries (Glewwe et al., 2014; Lavy, 2010; Long, 2013).

Where measured, however, the effect sizes for most school-level inputs are quite low, typically less than 15% of a standard deviation of the learning outcome measure. However, the effect sizes for teacher quality and teaching practice are quite high, amounting to over 40% of a standard deviation of learning outcomes measured in high-income countries (Hattie, 2013).

The OECD PISA instruments measure only a few of these items. Educational resources and quality of infrastructure are reported in two indices derived from the school questionnaire regarding shortages that are perceived to affect student performance; for analyses, the indices are reversed so that a higher number represents a more positive learning environment. Educational resources include science laboratory equipment, instructional materials, computers, Internet, computer software and library materials. Physical infrastructure includes buildings and grounds, heating/cooling and lighting, and classrooms. Teacher quality is measured in three ways: the proportion of teachers that are certified, the proportion of teachers who have higher education (ISCED 5A) and the proportion of teachers who have received recent



in-service training in mathematics. Instructional time is measured through student reports regarding the average length in minutes of class periods, and the number of class periods per week for mathematics, languages and science; these are combined as a measure of formal learning time for each subject.

Shortages in these key inputs are prevalent in various countries (Table 6.3). For example, in Colombia, Costa Rica, Peru and Tunisia, more than half of students attend schools where insufficiencies in instructional materials are reported. In several countries, the weekly time for regular mathematics lessons falls well below the OECD average, and students in middle-income countries report having covered less formal mathematics than students in OECD countries.

— Table 6.3 —

Selected educational resource inputs in 18 middle-income countries, PISA 2012

	Teacher quality (% with mathematics in-service training)	Teacher quality (% with ISCED 5A)	Instructional materials (% no-shortage)	Time (weekly minutes for mathematics lessons)
OECD Average	39	88	80	218
Argentina	48	18	62	267
Brazil	36	87	86	215
Bulgaria	36	--	75	134
Colombia	22	91	33	263
Costa Rica	46	84	43	207
Indonesia	42	82	62	209
Jordan	33	85	74	227
Kazakhstan	36	85	53	182
Malaysia	43	89	93	201
Mexico	47	88	60	253
Montenegro	46	89	60	142
Peru	33	77	42	287
Romania	45	96	71	169
Serbia	48	7	51	154
Thailand	73	99	63	206
Tunisia	40	87	41	276
Turkey	18	93	72	172
Viet Nam	50	87	73	227

Source: OECD (2013c), *PISA 2012 Results: What Makes Schools Successful (Volume IV): Resources, Policies and Practices*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264201156-en> (Figure IV.3.8, Tables IV.3.21, IV.3.6 and IV.3.12).

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The results from the OECD multi-level analyses, which control for both student-level and school-level socio-economic status, are summarised in Table 6.4 for 18 middle-income countries. In general, the inputs as measured by the OECD instruments are unrelated to differences in performance across schools in the majority of these middle-income countries, despite reported inadequacies of instructional materials such as textbooks and libraries in several countries. The physical infrastructure of the school is unrelated to performance in 15 countries and negatively related to performance in 3 countries.

— Table 6.4 —

School inputs and mathematics performance in 18 middle-income countries, PISA 2012

Education Inputs	PISA measure	Countries with positive correlation with performance	Countries with negative correlation with performance
Physical infrastructure	Index of quality of physical infrastructure	No country	Jordan, Romania, Turkey
Educational resources	Index of quality of educational resources	Costa Rica, Romania	No country
Teacher quality	Proportion of teachers with ISCED 5A	No country	Peru, Romania
	Proportion of teachers having attended professional development	Argentina, Malaysia	No country
Instructional time	School average of students' learning time per week	Argentina, Kazakhstan, Malaysia, Mexico, Turkey	Brazil

Note: Results from multi-level analyses, controlling for student and school demographics and socio-economic status; only statistically significant results are reported.

Source: OECD (2013c), *PISA 2012 Results: What Makes Schools Successful (Volume IV): Resources, Policies and Practices*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264201156-en> (Table IV.1.12c.).

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Educational resources are unrelated to performance in 16 countries and positively related to performance in Costa Rica and Romania. Teacher quality (university degree) is unrelated to performance in 16 countries and negatively related to performance in 2 countries, while in-service training is positively related to performance in 2 countries. Instructional time is unrelated to performance in 12 countries, positively related to performance in 5 countries, and negatively related to performance in 1 country.

Opportunity to learn and school climate matter in most countries

Studies in OECD countries regarding “what works” to raise student learning emphasise the importance of the opportunity to learn what is being taught (Schmidt, Zoido, and Cogan, 2014). To measure exposure to different contents of learning – which is typically referred to as the “implemented curriculum” – the PISA 2012 assessment asked students to recall their exposure to mathematical theories, concepts and content, and the amount of class time they spent studying this content.⁴ The answers to these questions were used to create three indices that measure opportunities to learn at the student level: “formal mathematics”, “word problems” and “applied mathematics.” Of these three sub-indicators of opportunities to learn, exposure to and experience with formal mathematics was found to be the strongest correlate of mathematics performance (Schmidt et al., 2014). The level of exposure to formal mathematics is relatively high in some of the low- and middle-income countries (Bulgaria, Jordan, Montenegro, Romania, Serbia and Viet Nam) even by OECD standards. In others, it is low (Argentina, Brazil and Tunisia).

PISA 2012 assessed three aspects of the school climate: *i*) degree of discipline among students; *ii*) the quality of relationships between students and their teachers; and *iii*) the values promoted and shared between teachers and students, and among the students themselves. Disciplinary climate was highly correlated with performance across all countries, with few exceptions (OECD, 2013c). To measure the disciplinary climate, PISA 2012 asked students to identify the frequency with which interruptions occur in mathematics lessons by indicating how often: students do not listen to what teachers have to say, there is noise and disorder, teachers have to wait a long time for students to calm down, students cannot work well, and students do not start working for a long time after the lesson begins. These responses were combined in the composite “index of disciplinary climate,” with a mean of zero and a standard deviation of 1 for OECD countries. Higher values indicate that students perceived a positive disciplinary climate in their classrooms, whereas a negative value indicates that students perceived a negative disciplinary climate in their classrooms. Among the middle-income countries, the indices were positive in 7 (Costa Rica, Indonesia, Kazakhstan, Mexico, Romania, Thailand, Viet Nam), and negative in 11 (Argentina, Brazil, Bulgaria, Colombia, Jordan, Malaysia, Montenegro, Peru, Serbia, Tunisia, Turkey) (OECD, 2013c).

Teaching practices and teacher’s knowledge matter

The meta-analysis literature on “what works” in high-income countries has consistently identified specific teaching practices as having the highest associations with student learning (Hattie 2013; Walberg 1984). Such influences include: teachers providing feedback to students, the quality of instruction, direct instruction, assigning homework and questioning; all these influences have effect sizes over 0.40. Where information has been available, prior research has documented the positive impact of teacher knowledge on student learning outcomes (Murnane and Ganimian, 2014). In the past, PISA instruments have neither included a teacher questionnaire to investigate teaching practices nor measured teacher subject matter knowledge. Recently, PISA 2012 results have been linked with the OECD’s Teaching and Learning International Study (TALIS) for six high-income countries, Mexico and Romania (Austin et al., 2015). For PISA 2015, a teacher questionnaire will be included.

Differences among students between and within schools

The OECD has recognised the importance of a student’s home background, and all OECD multi-level analyses have adjusted for these effects. Specifically, most analyses have introduced statistical controls for a student’s gender, home language and socio-economic background. In addition, the analyses control for a school’s urban or rural location, which can be considered a reasonably proxy for a student’s residence as well.

These student demographic characteristics are strongly correlated with performance in most of the middle-income countries analysed by the OECD (Table 6.5). For all countries in PISA 2012, a student’s socio-economic background was strongly and significantly associated with reading, mathematics and science performance. For simplicity, only the results for mathematics performance are presented in the table.

The OECD reports substantial performance gaps associated with many of the fixed characteristics of schools and students (Table 6.5). Students in urban schools outperformed students in rural schools in virtually all middle-income countries, and the gap exceeded the OECD average in about half of the countries. In most cases, these gaps amount to one or two



years of schooling. Only in Turkey did the scores of students in rural areas exceed those in urban areas. This could be due to two types of selection effects: *i*) the very small share of students attending school in rural areas in Turkey (2.3%, which is well below the OECD average); and *ii*) the policy of locating academically elite “Anatolia” high schools in all regions of the country, including rural areas.

— Table 6.5 —

Student background and mathematics performance, PISA 2012

Socio-economic and demographic student background	PISA measure	Significantly higher performance in:	Significantly lower performance in:
Gender	Female	Jordan, Malaysia, Thailand	Argentina, Brazil, Bulgaria, Colombia, Costa Rica, Kazakhstan, Mexico, Peru, Serbia, Tunisia, Viet Nam
Home language	Student speaks language of assessment at home (non-immigrants)	Argentina, Bulgaria, Mexico, Peru, Romania	Indonesia, Malaysia
Socio-economic background	OECD index of family socio-economic status	Argentina, Brazil, Bulgaria, Colombia, Costa Rica, Indonesia, Jordan, Kazakhstan, Malaysia, Mexico, Montenegro, Peru, Romania, Serbia, Thailand, Tunisia, Turkey, Viet Nam	No country

Sources: OECD (2014), *PISA 2012 Results: What Students Know and Can Do (Volume I, Revised edition, February 2014): Student Performance in Mathematics, Reading and Science*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264208780-en> (Table I.2.3a [gender]).

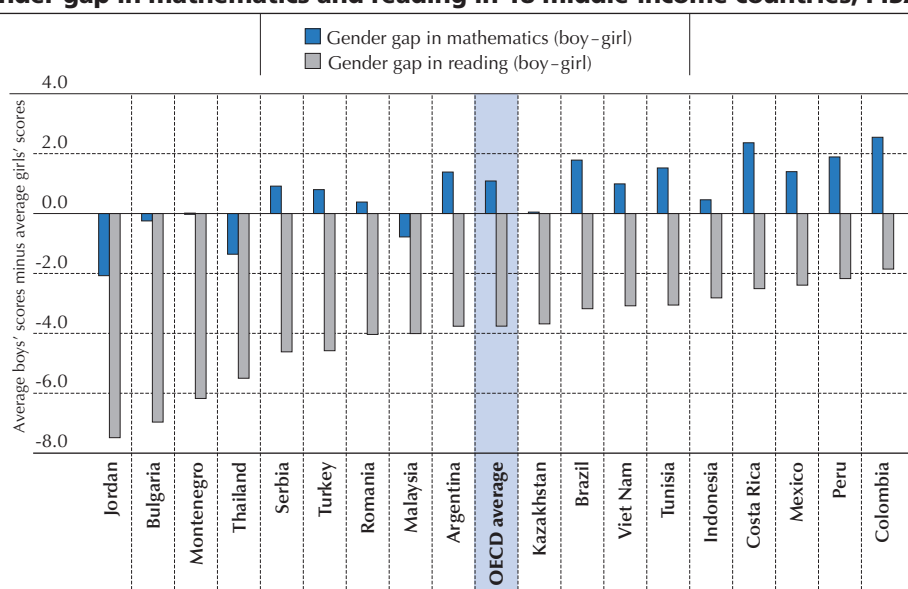
OECD (2013a), *PISA 2012 Results: Excellence through Equity (Volume II): Giving Every Student the Chance to Succeed*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264201132-en> (Table II.3.5 [language spoken at home], Table II.2.1 [socio-economic status]).

StatLink <http://dx.doi.org/10.1787/888933294084>

Gender effects differ for reading and mathematics. In many countries, boys outperformed girls in mathematics, whereas girls outperformed boys in reading (Figure 6.3). Girls significantly outperformed boys in reading performance in the middle-income countries. In more than half of these countries the female reading advantage even exceeded the female reading advantage in OECD countries. By comparison, boys outperformed girls in mathematics in OECD countries, although the statistically significant difference is small (11 points). In all the Latin American countries participating in PISA 2012, however, this difference in favour of boys in mathematics was quite substantial (Figure 6.3). In Jordan, Thailand and Malaysia, girls outperformed boys in mathematics.

— Figure 6.3 —

Gender gap in mathematics and reading in 18 middle-income countries, PISA 2012



Source: OECD (2014), *PISA 2012 Results: What Students Know and Can Do (Volume I, Revised edition, February 2014): Student Performance in Mathematics, Reading and Science*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264208780-en> (Table I.2.a).

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Home language that differs from the language of instruction was associated with lower mathematics scores in about half of participating countries and with higher mathematics scores in Indonesia and Malaysia. In several Latin American countries, these performance differences may reflect large indigenous ethnic minorities. In Bulgaria and Romania – two other countries with large language gaps – a large share of Roma may account for the gaps. In Malaysia and Indonesia, students who did not speak the language of assessment at home actually outperformed those who did. The OECD discusses language minority groups in the context of immigrants. In low- and middle-income countries, however, language minorities are often indigenous peoples who may not speak the official national language in their homes. In OECD countries, fewer than 5% of students were non-immigrant students who reported speaking a language other than the language of assessment in their home. In the low- and middle-income countries, this share was as high as 59% in Indonesia, 42% in Malaysia, 44% in Thailand, and 15% in Kazakhstan.

Gaps between the performance of students with a higher socio-economic status and those with a lower socio-economic status occur both within schools and between schools and, in general, are smaller in middle-income countries than the average OECD country. The student-level score point difference associated with a one-unit increase in student-level socio-economic status, and the school-level score-point difference associated with a one-unit increase in the school mean socio-economic profile, are lower than those in the average OECD country, with a few differences. In Kazakhstan, Malaysia and Romania, the within-school gap approaches that of the OECD average, and in Montenegro, Serbia and Turkey, the between-school gaps are higher than the OECD average. The relatively low gaps may simply be an artefact of the distribution of scores in these countries.


— Table 6.6 —

**Gaps in mathematics performance by student characteristics
in 18 middle-income countries, PISA 2012**

	Gender (boy–girl)	Socio-economic status within school	Socio-economic status between schools	Language at home	Location (urban/rural)
OECD Average	11*	19*	72*	33*	36*
Argentina	14*	9*	49*	45*	31*
Brazil	18*	8*	46*	-2	41*
Bulgaria	-2	12*	73*	77*	107*
Colombia	25*	11*	35*	36*	50*
Costa Rica	24*	10*	34*	-19	36*
Indonesia	5	6*	37*	4	48*
Jordan	-21*	11*	47*	1	38*
Kazakhstan	0	15*	45*	-12	23*
Malaysia	-8*	15*	49*	-31*	63*
Mexico	14*	5*	29*	47*	58*
Montenegro	0	12*	102*	21	--
Peru	19*	10*	49*	76*	89*
Romania	4	17*	57*	31*	60*
Serbia	9*	9*	101*	8	--
Thailand	-14*	9*	35*	12*	35*
Tunisia	15*	6*	45*	11	40*
Turkey	8	6*	83*	52*	-39
Viet Nam	10	8*	49*	52*	62*

* $p < .01$.

Source: OECD (2013c), *PISA 2012 Results: What Makes Schools Successful (Volume IV): Resources, Policies and Practices*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264201156-en> (Tables 1.2.3a, II.3.5, Figure II.5.1b, II.3.3.a, Table 1.3a, Table II.2.9a).

StatLink  <http://dx.doi.org/10.1787/888933294095>

Disadvantaged students, disadvantaged schools

OECD analyses investigate how disadvantaged students often attend disadvantaged, under-resourced schools. These analyses are reported at length in *PISA 2012 Results, Volume IV*, and this section summarises three of the findings regarding school inputs: instructional time, physical infrastructure, and educational resources.

In the majority of middle-income countries, socially advantaged schools (defined as a school whose students' mean socio-economic status is statistically significantly above the country/economy mean) benefit from more instructional time, a better physical infrastructure and more educational resources compared with socially disadvantaged schools (a school whose students' mean socio-economic status is statistically significantly below the country/economy mean).



— Table 6.7 —
Socio-economic school disadvantage and access to resources in 18 middle-income countries, PISA 2012

School resources	More resources in socially advantaged schools	No difference between socially advantaged and socially disadvantaged schools	More resources in socially disadvantaged schools
Learning time (per week in mathematics)	Argentina, Brazil, Bulgaria, Costa Rica, Indonesia, , Kazakhstan, Malaysia, Mexico, Montenegro, Peru, Serbia, Thailand, Tunisia, Turkey, Viet Nam	Jordan, Colombia, Romania	No country
Physical infrastructure	Argentina, Brazil, Colombia, Costa Rica, Indonesia, Mexico, Montenegro, Peru, Thailand, Turkey, Viet Nam	Jordan, Kazakhstan, Malaysia, Romania, Serbia, Tunisia	Bulgaria
Educational resources	Argentina, Brazil, Bulgaria, Colombia, Costa Rica, Indonesia, Jordan , Malaysia, Mexico, Peru, Romania Thailand, Tunisia, Turkey, Viet Nam	Kazakhstan, Montenegro, Serbia	No country

Source: OECD (2013c), *PISA 2012 Results: What Makes Schools Successful (Volume IV): Resources, Policies and Practices*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264201156-en> (Table IV.3.22).

In none of the middle-income countries do schools with a higher share of disadvantaged students receive more resources than schools with a higher share of advantaged students. These differences appear to be related to early tracking into vocational programmes in some countries, and the prevalence of private education, particularly in Latin America and Thailand. A few countries – notably Kazakhstan and Serbia – appear to provide both infrastructure and instructional materials equitably, regardless of the socio-economic composition of students in the schools.

The OECD has carried out extensive multi-level analyses of factors related to student learning. With the exception of the student's gender, home language and socio-economic status, and the school's socio-economic status, very few of the explanatory variables in the OECD models are statistically significant in more than a few countries.⁵ The results relating to school inputs and systemic differences have been summarised above. In addition, the OECD has examined a number of student attitudes and experiences, including the opportunity to learn material covered in the PISA assessment. The OECD's analysis, however, considers only a few of the variables in the PISA data set and tends to reflect indices constructed on the basis of questions developed for students and principals in OECD countries. Deeper analyses of PISA data may shed light on education in middle-income countries and policies that could lead to improvements in education in these countries. Such analyses are undertaken in the following section.

NEW ANALYSES: CORRELATES OF QUALITY AND SOURCES OF INEQUALITY

This section reports original analyses, undertaken specifically for this report, for the 18 middle-income countries that participated in the most recently completed PISA cycle, PISA 2012: Argentina, Brazil, Bulgaria, Colombia, Costa Rica, Indonesia, Jordan, Kazakhstan, Mexico, Montenegro, Malaysia, Peru, Romania, Serbia, Thailand, Tunisia, Turkey and Viet Nam. Countries not included in this analysis are Albania and Hungary.⁶ The analysis also does not include any of the economies in the People's Republic of China (hereafter 'China') that participated in PISA 2012, namely Hong Kong (China), Shanghai (China) and Macao (China), all of which are classified by the World Bank as high-income economies.

PISA 2012 assessed the competencies of 15-year-olds in reading, mathematics and science (with a focus on mathematics). The PISA 2012 data come from three sources: direct assessments of student performance, surveys of students, and surveys of schools. As PISA 2012 did not survey teachers, the information to characterise schools comes from the reports from school administrators about the physical academic and social characteristics of their schools, and from the reports from students about their schools, which are aggregated to the school level.

Three methodologies

The findings presented in this section come from original analyses based on three sets of models: *i*) multi-level analyses; *ii*) Oaxaca-Blinder counterfactual decomposition techniques (Blinder, 1973; Oaxaca, 1973); and *iii*) logistic regressions. Since the focus of PISA 2012 was on mathematics literacy, mathematics performance is the outcome used in these analyses, which use all five plausible values as estimated for each student. Each methodology is further described in the following sections.

Multi-level analyses for 18 middle-income countries

The multi-level models are specified as two-level regression models (student-level and school-level) within each country, with normally distributed residuals and maximum likelihood estimation. To account for the differences in sampling probabilities, both school and student weights are applied for all models, following standard OECD procedures (OECD, 2014). Models are estimated using Stata software.

The multi-level analysis began with an examination of each student-level variable separately and then in combination with other student-level variables; those variables most consistently related to mathematics performance were retained. Summary statistics are presented in Annex B. Various school-level factors were then examined to explore their additional contribution to student performance. This section discusses the results from the final regression in greater detail (Annex B, Model 12), but, for comparison, a number of different models are also included in Annex B and referred to in this section.

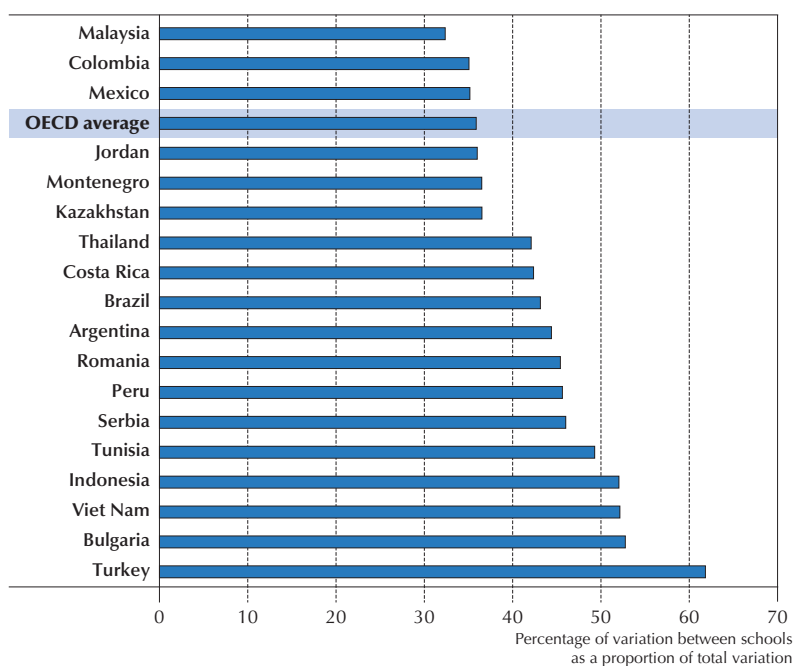
Variance in performance at two levels

The multi-level analysis begins with an analysis of the total variance in performance to be explained by student-level and school-level factors (Annex B, Model 1). These results can be presented as: *i*) the absolute size of the within-country performance variances; *ii*) the absolute size of the school-level and student-level performance variances; and *iii*) the share of the total variance in performance (between school variance plus within-school variance) that is due to variance between schools. This latter measure, the intra-class correlation, is referred to as “academic segregation” in the OECD documents.

Most middle-income countries exhibit more academic segregation compared to OECD countries. On average in OECD countries, 37% of the total variance in performance comes from “between school” variance in performance and 63% comes from “within-school” variance. This is not the pattern in most of the middle-income countries. In 11 of the 18 middle-income countries, the percentage of total variance accounted for by between-school variance is approximately 10 percentage points higher than for the OECD countries. In four of these countries, Bulgaria, Indonesia, Turkey and Viet Nam, the difference is greater than 15 percentage points. In some countries, the between-school share falls below that of OECD countries, but only by 1 or 2 percentage points (Figure 6.4).

Figure 6.4

Between school variance in mathematics performance, by country, PISA 2012



Source: Author's analysis; OECD (2013a), *PISA 2012 Results: Excellence through Equity (Volume II): Giving Every Student the Chance to Succeed*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264201132-en> (Table II.2.8a).

StatLink <http://dx.doi.org/10.1787/888933293930>



Education systems that exhibit a low share of total variation due to between-school variation indicate that student performance is likely to be the same regardless of which school they attend, but that students in the same school are performing at different levels. Education systems that exhibit a high share of total variance due to between-school variation indicate either that some schools are more “effective” than others, or that students are sorted into schools on the basis of their performance, and hence are performing at similar levels within these schools.

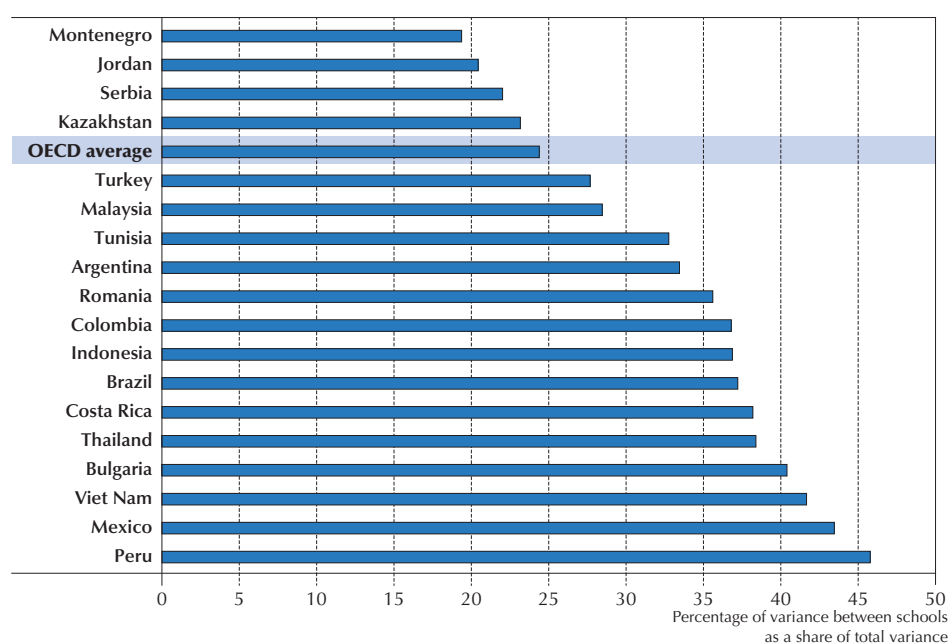
Variance in socio-economic status at two levels

Most middle-income countries exhibit greater social segregation compared with OECD countries. As with variance in performance, variance in the socio-economic status of students can be examined at two levels. The ratio of the between-school school variance in socio-economic status to the total variance in socio-economic status is defined as the “intra-class correlation” of this measure, which is called “social segregation.”

On average in OECD countries, 24% of the variance in socio-economic status among students comes from “between school” variance in socio-economic status and 76% comes from “within school” variance. This is not the pattern for the middle-income countries in the PISA 2012 group (Figure 6.5). In 14 of these 18 countries, a much higher share of the variance in socio-economic student background occurs between schools compared to the OECD average, suggesting that the socio-economic background of students may be more of a determining factor in which school they attend. Unlike academic segregation, which is often a consequence of explicit educational policy, social segregation is likely to be a consequence of conscious or unconscious choices made by families, who may live in socio-economically homogeneous school “catchment” areas or may choose to enrol their children in private schools.

Figure 6.5

Between school variance in socio-economics status in 18 middle-income countries, PISA 2012



Source: OECD (2013a), *PISA 2012 Results: Excellence through Equity (Volume II): Giving Every Student the Chance to Succeed*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264201132-en> (Figure II.5.1b).

StatLink <http://dx.doi.org/10.1787/888933293948>

Social segregation is higher than the OECD average in all countries in Latin America, and in a few countries – Peru and Mexico, in particular – approximately 20 percentage points more of the variance in students’ socio-economic background comes from between-school differences. This strongly suggests that students within the same school have similar socio-economic backgrounds, and that students having different types of socio-economic backgrounds do not attend the same schools. This has implications for how resources are distributed to schools and what policies may be needed to improve their quality.

WHAT DOES PISA DATA TELL US ABOUT EDUCATION IN MIDDLE-INCOME COUNTRIES?

A much higher share of both performance variation and socio-economic status variation occurs between schools in these middle-income countries than occurs between schools in OECD countries on average. However countries differ in the degree to which their schools are both academically and socially segregated. Eight countries exhibit both high academic segregation and high social segregation (Brazil, Bulgaria, Costa Rica, Indonesia, Peru, Romania, Thailand, Viet Nam, and four countries exhibit both low academic segregation and low social segregation Jordan, Kazakhstan, Malaysia, Montenegro). Colombia and Mexico exhibit high social segregation and low academic segregation, while Argentina, Serbia, Tunisia and Turkey exhibit high academic segregation and low social segregation.

Student-level influences on performance

In the multi-level analyses reported in *PISA 2012 Results: Volume IV* (OECD, 2013c), the OECD examined the effects on mathematics performance of students' socio-economic background, gender, language and the school's urban-rural location. The new multi-level analyses summarised in this section added four more characteristics at the student level: student grade, student grade repetition, school track (vocational versus general) and student pre-primary school attendance. These four characteristics are not immutable background characteristics and can be affected by education system policies related to the provision of pre-primary education, the age of school entry, requirements for progressing through the various grade levels, and tracking policies.

The new multi-level analyses found that a student's socio-economic background, gender, home language and residence were all strongly correlated with their PISA 2012 mathematics performance (Annex B, Model 5), which is consistent with the analyses reported by the OECD.

Students from more **socio-economically advantaged backgrounds** scored higher than those from less advantaged backgrounds in all countries other than Turkey. Home support for learning, as indicated by the number of books in the home,⁷ is associated with better performance (Annex C).

In 14 countries, boys outperformed girls in mathematics, but **gender** was unrelated to mathematics performance in Jordan, Kazakhstan, Malaysia and Thailand (Annex B, Model 2). When all family background and school-level variables were considered simultaneously, boys outperformed girls in all countries other than Malaysia and Thailand (Annex B, Model 12).

Speaking the **language of the assessment** at home was positively associated with mathematics performance in nine countries (Argentina, Brazil, Bulgaria, Colombia, Jordan, Mexico, Peru, Tunisia and Viet Nam) and negatively associated with performance in two countries, (Indonesia and Thailand) possibly reflecting the presence of high-performing minority-language groups in these countries (Annex B, Model 3). When all family background and school-level variables were considered simultaneously, the language spoken at home continued to be positively correlated with performance in five countries (Bulgaria, Colombia, Jordan, Mexico and Peru), but in three countries (Indonesia, Malaysia, Thailand) those who did not speak the language of instruction at home outperformed those who did (Annex B, Model 12).

Students attending **schools located in a village** (and by inference, students living in a village, i.e. **rural students**) performed less well than those attending town or city schools (urban students) (Annex B, Model 4). These results are largely consistent with those reported by OECD. However, when all family background and school-level variables were considered simultaneously, students in rural schools performed the same as students in schools in other communities in all countries other than Brazil and Jordan, where their performance was higher (Annex B, Model 12).

In addition to these student characteristics, the new analyses looked at the effects of grade level, grade repetition, school track and preschool experience (all considered concurrently in Annex B, Model 10).

The **grade level** in which a student is enrolled strongly affects his or her performance, with students enrolled in higher grades scoring significantly above those enrolled in lower grades; this is the case for all countries other than Montenegro and Romania. In 13 countries, most 15-year-olds are enrolled in grade 10 (the "modal" grade in these countries), whereas in five countries most 15-year-olds are enrolled in grade 9 (the "modal" grade in these countries), but in all countries, students enrolled in a grade higher than the modal grade out-perform students in the modal grade, whereas students enrolled in grades below the modal grade perform less well, after controlling for repetition. This is undoubtedly due to differences in the opportunity to learn some skills that are tested on the PISA assessment.

The importance of **grade repetition**⁸ in all 18 middle-income countries is visible from the large differences in mathematics performance between students who have and students who have not repeated a grade. Students who have repeated a grade at any time scored 30 points or more below those who had not repeated in Bulgaria, Jordan, Mexico, Montenegro and Serbia. This suggests that in some countries, students who are performing less well are retained in lower grades, keeping them in the system rather than excluding them.



Students in **vocational tracks** scored significantly above students in general education in three countries (Colombia, Costa Rica and Mexico) and significantly below students in general education tracks in seven countries (Bulgaria, Brazil, Kazakhstan, Montenegro, Malaysia, Serbia and Thailand), suggesting that either tracking policies based on student performance were in place or that students in the two tracks did not have the same opportunity to learn (Annex B, Model 7). In four countries (Jordan, Peru, Romania and Tunisia), not enough students were enrolled in vocational tracks to permit analysis.

A student's socio-economic background may be strongly related to a student's experience of **pre-primary education**, particularly when it is not universal and must be privately obtained. Nonetheless, even when the socio-economic background of the student is taken into account, the PISA 2012 mathematics scores of students with pre-primary experience were higher than the scores of those lacking this experience, although the level of this effect was statistically significant in only about half of the middle-income countries.

School-level influences on performance

Consistent with the previous OECD analysis, the new multi-level analyses find that once the socio-economic composition of the school is taken into account, most school inputs – infrastructure, educational resources, teacher quality and instructional time – are only modestly related to student performance (Annex B, Model 12).⁹ These are all closely related to the socio-economic makeup of the schools themselves.

The **school physical infrastructure**, as measured by the PISA index, was related to student performance in only three countries: more resources were related to higher performance in Montenegro and Thailand and lower performance in Romania. The availability of educational resources was positively related to student performance in three countries: Brazil, Costa Rica and Romania. None of the **teacher quality** measures, including the proportion of teachers with higher education (International Standard Classification of Education [ISCED] 5A), were related to student performance. More **instructional time**, however, was positively associated with higher performance in eight countries (Argentina, Bulgaria, Indonesia, Kazakhstan, Mexico, Malaysia, Romania and Turkey).

The OECD analyses examined three **school climate** measures (disciplinary climate, student-teacher relationships, shared values) and the new multi-level analyses found that the disciplinary climate was the sole aspect of school climate that significantly contributed to an improvement of learning outcomes in middle-income countries. It is also one of the strongest and most consistent predictors of learning at the school level. Students in schools with a better disciplinary climate significantly outperformed students in schools with a less positive disciplinary climate in 13 countries. A school's average level of student absenteeism was strongly and negatively related to performance.

The new multi-level regression analyses show that **opportunity to learn** (i.e. exposure to formal mathematics) was associated with higher mathematics performance in all middle-income countries, but may also reflect a student's grade level and national study programme (Annex B, Model 11).

Institutions

Private education and tracking are strongly related to student performance in many middle-income countries. In eleven middle-income countries, over 5% of students were enrolled in a private school (Annex B, Descriptive Statistics). Students enrolled in **private schools** outperformed those enrolled in public schools in eight countries (Annex B, Model 8), but these performance differences were sharply reduced once school and student socio-economic status were taken into account (Annex B, Model 8a). In relation to **tracking**, four middle-income countries reported a very high share of students in vocational programmes: Serbia (74%), Montenegro (66%), Bulgaria (41%) and Turkey (38%). All of these were significantly higher shares than in OECD countries (OECD, 2013c, Table IV.2.6).

Oaxaca-Blinder decomposition of private school and tracking effects

Two systemic differences that exist among countries are explored in this analysis: *i*) the degree of stratification of their educational systems through tracking; and *ii*) the nature of selection for different schools, particularly private schools. Highly stratified systems, such as those in Bulgaria, Montenegro and Serbia, practice early selection based on prior academic ability and group students into differentiated educational programmes (typically, vocational tracks versus general education tracks). In comprehensive systems, education is not differentiated by ability. However, private education offers competition to public education and access is largely determined by a family's economic status, particularly in Latin American countries.¹⁰ Both types of differences are associated with large differences in student performance in some middle-income countries.

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This section analyses the factors that account for these two difference in performance between general and vocational schools and between public and private schools using the decomposition method often referred to as “Oaxaca-Blinder” decomposition (Blinder, 1973; Oaxaca, 1973). The decomposition technique was originally used in sociology and demography, but was popularised in economics literature to decompose male/female earnings gaps. It has since been used to decompose learning gaps in education in Indonesia (Barrera-Orsorio et al., 2011). In this section, the same method is used to examine the gap between student performance in vocational versus academic tracks, and between student performance in public and private schools.

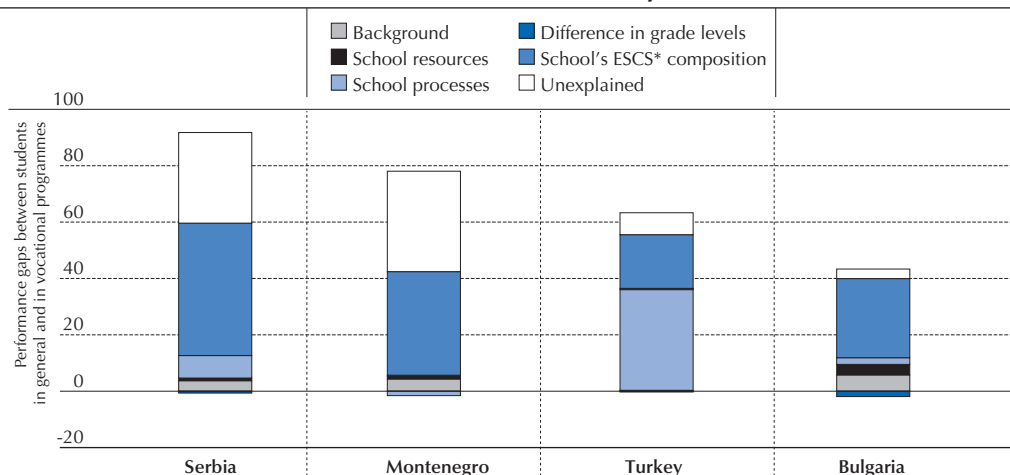
The method, as applied in this section, divides the mathematics performance score differential between two groups into one part that is “explained” by observable group differences in family, student and school characteristics, and a residual part that cannot be accounted for. This “unexplained” part often subsumes the effects of group differences in unobserved predictors (for a detailed description of the technique used see Jann, 2008).

Accounting for the vocational-academic gap

Early tracking appears to separate students into general education programmes and vocational programmes based on their performance towards the end of the basic education cycle. Performance gaps between students enrolled in general programmes and those enrolled in vocational programmes are found among 15-year-olds participating in PISA and are the largest in Serbia (91 points higher in general schools) and Montenegro (76 points), followed by Turkey (63 points); they are much less pronounced in Bulgaria (41 points). A decomposition of these gaps shows that in Bulgaria, Montenegro and Serbia, the largest share of the performance gaps between students in these two types of programme can be accounted for by differences in the socio-economic composition of students in general versus vocational schools; this is not the case in Turkey (Figure 6.6). In Turkey, the largest share of the performance gap can be accounted for by differences in school processes (disciplinary climate and instructional time), followed by differences in the socio-economic composition of the schools. In both Serbia and Montenegro, however, much of the performance gap remains unaccounted for.


— Figure 6.6 —

Decomposition of mathematics performance gap between general and vocational programmes in 4 middle-income countries, PISA 2012



* ESCS refers to the PISA index of economic, social and cultural status.

Source: Authors' original analyses of PISA 2012 Database.

StatLink  <http://dx.doi.org/10.1787/888933293951>

Accounting for the public-private gap

Nine of the 18 middle-income countries have a high share of students enrolled in private schools: all the Latin American countries (9%–32%), Indonesia (41% of students), Jordan (17%), and Thailand (17%). The following countries have fewer than 2% of students enrolled in private schools: Bulgaria, Montenegro, Romania, Serbia, Tunisia and Turkey.

Gaps in performance between private and public schools, with students in private schools outperforming those in public schools, are large in Malaysia (87 points), Brazil (80 points), Costa Rica (78 points), Peru (65 points), Jordan (60 points), Argentina (58 points), Colombia (50 points), and Mexico (42 points). In Thailand, students in private schools underperform students in public schools (Annex B Model 8).

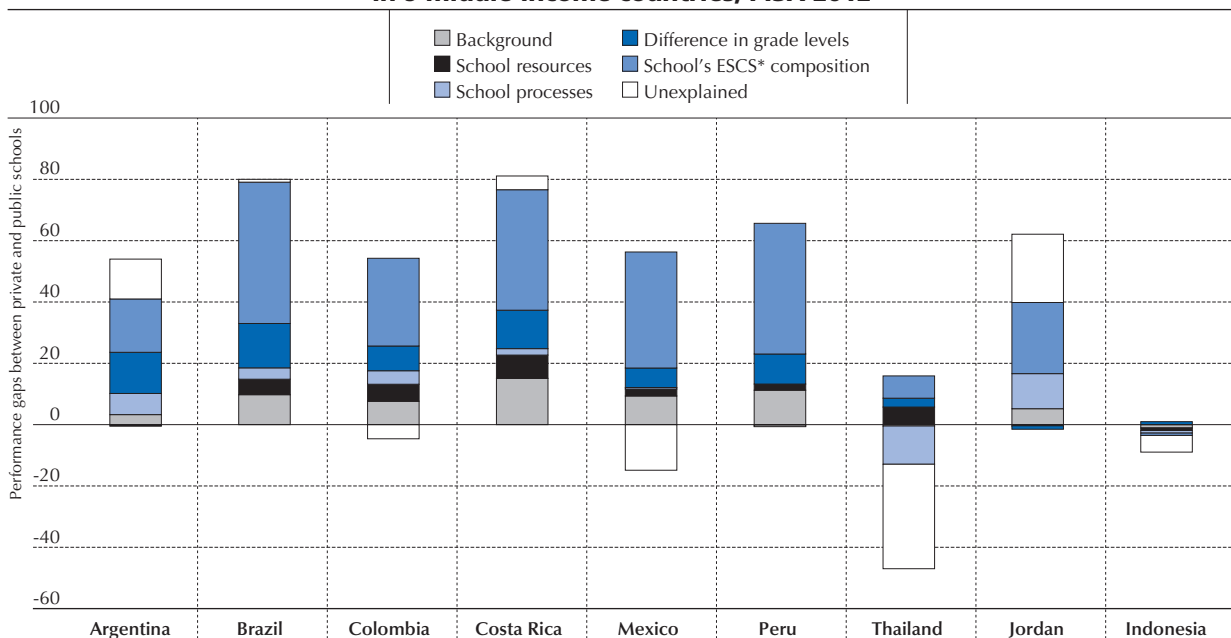


Performance gaps between public and private schools can be largely explained by: *i)* students' socio-economic background; *ii)* the school's socio-economic composition; and *iii)* the high share of students in a grade below the modal grade for 15-year-olds. Little is left unexplained in most of the Latin American countries, although large amounts are left unexplained in Thailand and Jordan (Figure 6.7). This suggests that social segregation is an important factor in explaining performance differences across students, particularly for Brazil, Colombia, Costa Rica, Mexico and Peru.

Students from disadvantaged backgrounds are often doubly disadvantaged: not only do they come from a home environment that may be less encouraging of school learning, but the schools they attend may also be less advantaged. For all countries other than Thailand and Indonesia, most of the performance difference between public school students and private schools students can be attributed to differences between the students that attend such schools. Similarly, most differences between the performance of students in vocational schools and those in general secondary schools can be attributed to differences in the socio-economic status of students attending these two different types of schools.

— Figure 6.7 —

Decomposition of mathematics performance gap between private and public schools in 9 middle-income countries, PISA 2012



* ESCS refers to the PISA index of economic, social and cultural status.

Source: Authors' original analyses of PISA 2012 Database.

StatLink <http://dx.doi.org/10.1787/888933293963>

Odds of being in a disadvantaged school

The analysis of PISA data undertaken in this chapter has underscored the importance of both a student's own socio-economic background and the average socio-economic background of a school's students as strong correlates of performance. The analyses have also suggested that when student and school socio-economic background are taken into account, most other school inputs are considerably less related to student performance.

The final set of analyses carried out for this report examines the odds of being enrolled in an advantaged school. Advantaged schools are defined as having one or more of the following: an adequate school building and grounds, sufficient classrooms, electricity and climate control, qualified mathematics teachers, adequate instructional materials, and adequate library materials. Each of these advantages are examined separately, and the questions are: do students with a higher socio-economic background have higher odds of attending a school that has one or more of these advantages, compared to students from a lower socio-economic background? And are these odds different in countries with relatively higher shares of students in vocational schools or private schools? No countries have both a high share of students in vocational programmes and a high share in private schools. Table 6.8 summarises these odds; details are provided in Annex B.

— Table 6.8 —

Odds of a student being enrolled in schools with adequate inputs, selected countries, PISA 2012

School resource advantage	Countries where students with higher socio-economic background have higher odds of attending a school with resource advantage	
	Countries with more than 35% of students in vocational programmes (Bulgaria, Montenegro, Serbia, Turkey)	Countries with more than 9% of students in private schools (Argentina, Brazil, Colombia, Costa Rica, Indonesia, Mexico, Peru, Thailand)
Qualified mathematics teachers	Bulgaria, Montenegro, Turkey	Brazil, Indonesia Jordan, Mexico, Peru
Instructional materials	Bulgaria, Montenegro	Brazil, Colombia, Costa Rica, Indonesia, Mexico, Peru
Library materials	Bulgaria, Montenegro, Turkey	Brazil, Colombia, Costa Rica, Indonesia, Jordan, Mexico, Peru
School buildings and grounds	Bulgaria, Montenegro, Turkey	Argentina, Brazil, Colombia, Costa Rica, Indonesia, Jordan, Mexico, Peru
Heating/cooling and lighting	Montenegro, Turkey	Argentina, Brazil, Costa Rica, Indonesia, Jordan, Mexico, Peru, Thailand
Instructional space	Bulgaria, Montenegro, Turkey	Argentina, Brazil, Costa Rica, Indonesia, Mexico, Peru

Source: Author's original analysis of PISA 2012 Database.

Students from higher socio-economic backgrounds in three of the four countries with early tracking, as indicated by the share of students in vocational programmes, are more likely to be attending schools that have higher quality educational resources (Bulgaria, Montenegro and Turkey). Similarly, students from socially-advantaged backgrounds in most of the countries with a substantial share of students enrolled in private schools are more likely to be attending schools that have higher quality educational resources (Argentina, Brazil, Colombia, Costa Rica, Indonesia, Jordan, Mexico and Peru). There are, however, exceptions: in Serbia, a country with a high share of students in vocational programmes, and in Thailand, a country with a high share of private schools, socially advantaged students are not more likely to be in schools that have higher quality educational resources.

Different mechanisms appear to lie behind the sorting of students into different schools in low- and middle-income countries. In some Latin American countries, social segregation and income inequality is reflected in the high social segregation between schools; ethnicity and rural residence are often associated with these differences. In the former socialist countries and Turkey, academic excellence is the sorting mechanism behind channelling children into different schools. As a consequence, these countries combine low levels of social segregation with high levels of academic segregation. Somewhere in between these two cases is Viet Nam, the best-performing country among the middle-income countries studied, which combines high academic segregation with relatively high social segregation between schools.¹¹

CONCLUSIONS AND IMPLICATIONS FOR PISA IN MIDDLE-INCOME COUNTRIES

Conclusions

PISA provides participating countries with considerable information that can enable them to identify issues related to education quality and equity within their own country. In particular:

1. PISA shows that the quality of human capital in middle-income countries, as measured by PISA assessments, is, with the exception of Viet Nam, lower than in high-income countries. In accordance with their economic development, all of these middle-income countries have considerably fewer financial resources invested in their education systems. The average socio-economic background of the students is also much lower than in the high-income countries.
2. PISA identifies educational inequalities that vary among countries, but that are associated with a student's gender, socio-economic status and home language (a proxy for ethnicity).
3. PISA demonstrates that socio-economically disadvantaged students frequently attend resource-disadvantaged schools in middle-income countries.



PISA also provides information about aspects of the education system overall that can be the topic of policy discussion. In particular, PISA identifies two important aspects of stratification in education: academic stratification and social stratification:

1. Some former socialist countries and Turkey, unlike most OECD countries, combine high academic segregation between schools with low social segregation within schools. The latter is a direct consequence of traditionally low socio-economic inequalities beyond the education system, and low residential segregation in these countries. In these systems, the socio-economic background of students may play a role in sorting students into different school tracks, but is less relevant once the students have been sorted.
2. At the other extreme are many Latin American countries, where socio-economic inequalities result in social stratification between schools but low academic segregation within schools. In these countries, a lack of academic selection enables wealth to be the sole mechanism for sorting children across schools. As a result, the socially advantaged have greater access to high levels of educational resources, often provided through elite private schools.

The new multi-level analysis of the PISA 2012 mathematics assessment identified four school-level characteristics that are associated with higher student performance in middle-income countries, after the effects of other background characteristics are statistically controlled. These are: learning and instructional time, school climate, engagement with and at school, and opportunities to learn.

At the same time, the PISA results to date may have less relevance for middle-income countries, for two reasons: *i)* the comparability across countries of the students assessed; and *ii)* the relevance of the PISA performance measures themselves for middle-income countries.

1. As mentioned above, in some countries a substantial proportion of the 15-year-olds enrolled in school are enrolled in grades considerably lower than the modal grade for their age and country: often in grades 7 or 8, rather than grades 9 or 10 as in OECD countries. In addition, out-of-school rates for lower secondary school children are high in many low- and middle-income countries, exceeding 10% in Argentina, Bulgaria, Jordan, Mexico, Thailand and Turkey. The rate is exceptionally high in Viet Nam, at 37%. This implies selection bias among the population eligible for the PISA survey in these countries. The combination of these two exclusion mechanisms, plus other minor exclusion criteria,¹² result in indices of coverage of the 15-year-old population as low as 50% in Costa Rica, 56% in Viet Nam, and 63% in Indonesia, compared with 96% for OECD countries. These relatively low levels of coverage limit the comparability of the results of middle-income countries with other countries.
2. The characteristics of the PISA mathematics scores in middle-income countries also differ somewhat from those in high-income OECD countries (for which the tests were originally designed), which have a mean of about 500 and a standard deviation of about 100. In the middle-income countries, scores on the PISA 2012 mathematics assessment, while normally distributed, have much lower means and a smaller standard deviation. In many countries, well over 50% of students achieve scores lower than 420 on the scale (at Level 1 or below in mathematics proficiency), compared with an OECD average of 23%.

Finally, the analyses carried out in this chapter point to several areas that could be improved for PISA survey instruments to better represent the situation in middle-income countries:

1. While PISA aims to collect information on the quality of teachers and teaching, a great deal of essential information about these important determinants of learning in developing countries is missing from PISA. Moreover, the quality of information that is provided is hampered by imprecision: principals assess the general quality of the teachers in their schools, rather than the quality of individual teachers. A principal's bias could affect this measure; moreover, this measure does not provide information about individual teachers. Specifically, more precise information is needed about teachers' knowledge of the subject content and about the level of their pedagogical skills. More information is also needed on instructional processes, particularly about how class time is spent, for example in independent activities, such as working in workbooks, versus small group activity and whole-class teacher-centred instruction (Willms and Tramonte, 2015). The OECD could assist partner countries in improving the collection of information on this very important aspect of the learning environment as an aid to development projects.
2. There is much evidence that variations in the amount of educational resources available to students in schools affect learning in developing countries, yet this relationship is not significant in the PISA study. The PISA survey instruments emphasise features of schools that may be less important in lower-middle-income countries, such as availability of computers and the Internet. Moreover, these school-level resources are often linked to the socio-economic composition of schools, particularly in Latin America, where the difference in resource allocation between advantaged and disadvantaged schools is very high.



WHAT DOES PISA DATA TELL US ABOUT EDUCATION IN MIDDLE-INCOME COUNTRIES?

Implications

There are several implications for the future utilisation of PISA for greater application to middle-income countries, for both middle-income countries and the OECD.

Implications for middle-income countries

In order to improve the relevance of PISA for middle-income countries, countries are encouraged to participate more actively in the development of instruments and the completion of analyses relating to policy issues of concern in their countries.

Implications for the OECD

As has been anticipated by the PISA for Development initiative, the OECD will need to acknowledge the differences between the countries currently and historically participating in PISA, and the low- and middle-income countries that are not currently participating in PISA, by:

1. Adapting the cognitive instruments to better capture performance differences at the lower end of the performance scale. An analysis of the needs in this respect is currently underway by Adams and Cresswell (2014).
2. Adapting the questionnaires to better measures institutions and inputs that are relevant to these countries. An analysis of the questionnaires is currently underway by Willms and Tramonte (2015).

The OECD will also need to consider how to revise some of the regular OECD analyses of PISA to focus on middle-income country participants, rather than grouping all non-OECD partner countries/economies into a single group by:

1. Analysing results separately by income group.
2. Analysing results separately by world region.



Notes

1. The following middle-income countries/economies are not included, for the following reasons: *i)* Albania lacked information on student socio-economic status; *ii)* China's data referred to Shanghai only; and *iii)* Hungary was a high-income country from 2009 to 2013.
2. This chapter is based on a background paper prepared by Tijana Prokic-Breuer.
3. OECD measures mathematics proficiency on a scale having a mean value of 500 and a standard deviation of 100. Six proficiency levels are reported: Level 6 (669 points or above), Level 5 (607-668 points), Level 4 (545-606 points), Level 3 (482-544), Level 2 (420-481), Level 1 (358-419).
4. Issues of endogeneity affect this measure, since students who are attending their lessons may both recall more exposure and have higher mathematics performance.
5. The OECD provides many reasons why school-level variables may not be associated with student achievement; nevertheless, the OECD does carry out these analyses.
6. Reasons for exclusion were: *i)* Albania lacked information on student socio-economic status; and *ii)* Hungary was a high-income country from 2009 to 2013.
7. See Carnoy and Rothstein (2013) for a discussion of this variable.
8. Controlling for grade of enrolment; repetition is dummy indicating whether or not the student has reported having repeated a grade in either primary, secondary or upper secondary school.
9. To avoid "overcontrolling" the models presented in Annex B contain fewer school-level variables than the ones presented in OECD, 2014. Moreover, the variables in the new analyses were introduced carefully into the basic model and tested for their independent effects before incorporating them into the full model.
10. In some Latin American countries, voucher systems open the opportunity for disadvantaged students to afford private schooling.
11. Viet Nam's high performance in PISA 2012 has attracted considerable attention. However, in Viet Nam, only about 55% of 15-year-olds are in school in eligible PISA grades, suggesting that the average performance would be lower if a representative sample of 15-year-olds were selected for assessment.
12. Details can be found in OECD, 2014.

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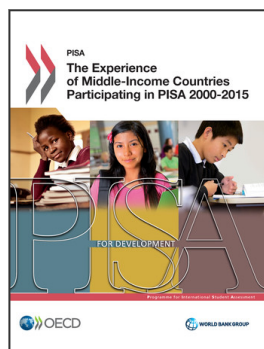
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