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PISA as a Yardstick for Educational Success

More and more countries are looking beyond their own borders for evidence of the most successful and efficient policies and practices. Over the past decade, the OECD Programme for International Student Assessment (PISA) has become the world's premier yardstick for evaluating the quality, equity and efficiency of school systems. This chapter introduces PISA and sets the scene for situating the PISA performance of 15-year-olds in the United States against global patterns and trends.



SITUATING PISA AS A YARDSTICK FOR EDUCATIONAL SUCCESS

Equipping citizens with the skills necessary to achieve their full potential, participate in an increasingly interconnected global economy, and ultimately convert better jobs into better lives is a central preoccupation of policy makers around the world. Results from the OECD's recent Survey of Adult Skills (OECD, 2013a) show that highly skilled adults are twice as likely to be employed and almost three times more likely to earn an above-median salary than poorly skilled adults. In other words, poor skills severely limit people's access to better-paying and more rewarding jobs. Highly skilled people are also more likely to volunteer, see themselves as actors rather than as objects of political processes, and are more likely to trust others. Fairness, integrity and inclusiveness in public policy thus all hinge on the skills of citizens.

Furthermore, the ongoing economic crisis has only increased the urgency of investing in the acquisition and development of citizens' skills – both through the education system and in the workplace. At a time when public budgets are tight and there is little room for further monetary and fiscal stimulus, investing in structural reforms to boost productivity, such as education and skills development, is key to future growth. Indeed, investment in these areas is essential to support the recovery as well as to address long-standing issues, such as youth unemployment and gender inequality.

In this context, more and more countries are looking beyond their own borders for evidence of the most successful and efficient policies and practices. Indeed, in a global economy, success is no longer measured against national standards alone, but against the best-performing and most rapidly improving education systems. Over the past decade, the OECD Programme for International Student Assessment (PISA) has become the world's premier yardstick for evaluating the quality, equity and efficiency of school systems. But the evidence base that PISA has produced goes well beyond statistical benchmarking. By identifying the characteristics of high-performing education systems PISA allows governments and educators to identify effective policies that they can then adapt to their local contexts.

The results from the PISA 2012 assessment, which was conducted at a time when many of the 65 participating countries and economies were grappling with the effects of the economic crisis, reveal wide differences in education outcomes, both within and across countries. Using the data collected in previous PISA rounds, we have been able to track the evolution of student performance over time and across subjects. Of the 64 countries and economies with comparable data, 40 improved their average performance in at least one subject. Top performers such as Shanghai in China and Singapore were able to further extend their lead, while countries like Brazil, Mexico, Tunisia and Turkey achieved major improvements from previously low levels of performance.

Some education systems have demonstrated that it is possible to secure strong and equitable learning outcomes at the same time as achieving rapid improvements. Of the 13 countries and economies that significantly improved their mathematics performance between 2003 and 2012, three also show improvements in equity in education during the same period, and another nine improved their performance while maintaining an already high level of equity – proving that countries do not have to sacrifice high performance to achieve equity in education opportunities.

Nonetheless, PISA 2012 results show wide differences between countries in mathematics performance. The equivalent of almost six years of schooling, 245 score points, separates the highest and lowest average performances of the countries that took part in the PISA 2012 mathematics assessment. The difference in mathematics performances within countries is even greater, with over 300 points – the equivalent of more than seven years of schooling – often separating the highest- and the lowest-achieving students in a country. Clearly, all countries and economies have excellent students, but few have enabled all students to excel.

The report also reveals worrying gender differences in students' attitudes towards mathematics: even when girls perform as well as boys in mathematics, they report less perseverance, less motivation to learn mathematics, less belief in their own mathematics skills, and higher levels of anxiety about mathematics. While the average girl underperforms in mathematics compared with the average boy, the gender gap in favour of boys is even wider among the highest-achieving students. These findings have serious implications not only for higher education, where young women are already under-represented in the science, technology, engineering and mathematics fields of study, but also later on, when these young women enter the labour market. This confirms the findings of the OECD Gender Strategy, which identifies some of the factors that create – and widen – the gender gap in education, labour and entrepreneurship. Supporting girls' positive attitudes towards and investment in learning mathematics will go a long way towards narrowing this gap.

PISA 2012 also finds that the highest-performing school systems are those that allocate educational resources more equitably among advantaged and disadvantaged schools and that grant more autonomy over curricula and assessments to individual schools. A belief that all students can achieve at a high level, and a willingness to engage all stakeholders



in education – including students, through such channels as seeking student feedback on teaching practices – are hallmarks of successful school systems.

PISA is not only an accurate indicator of students' abilities to participate fully in society after compulsory school, but also a powerful tool that countries and economies can use to fine-tune their education policies. There is no single combination of policies and practices that will work for everyone, everywhere. Every country has room for improvement, even the top performers. That's why the OECD produces this triennial report on the state of education across the globe: to share evidence of the best policies and practices and to offer our timely and targeted support to help countries provide the best education possible for all of their students. With high levels of youth unemployment, rising inequality, a significant gender gap and an urgent need to boost growth in many countries, we have no time to lose. The OECD stands ready to support policy makers in this challenging and crucial endeavour.

For the United States, as for other countries, the results from the OECD Survey of Adult Skills (PIAAC) provides a new context in which the results from PISA can be examined. The Adult Skills Survey showed:

- Larger proportions of adults in the United States than in other countries have poor literacy and numeracy skills, and the proportion of adults with poor skills in problem solving in technology-rich environments is slightly larger than the average, despite the relatively high educational attainment among adults in the United States.
- Socio-economic background has a stronger impact on adult literacy skills in the United States than in other countries. Black and Hispanic adults are substantially over-represented in the low-skilled population.
- Literacy skills are linked not only to employment outcomes, but also to personal and social well-being. In the United States, the odds of being in poor health are four times greater for low-skilled adults than for those with the highest proficiency – double the average across participating countries.

But the results from the Survey of Adult Skills also showed the importance of developing key skills through school in order to provide a strong foundation for skills development later in life. The results show that, overall, there is a reasonably close correlation between countries' performance across the successive PISA assessments and the proficiency of the corresponding age cohorts in literacy and numeracy in the Survey of Adult Skills. Countries which performed well in PISA in a given year (e.g. 2000) tend to show high performance among the corresponding age cohort (e.g. 27-year-olds) in the Survey of Adult Skills and vice versa. This suggests that, at the country level, the reading and mathematics proficiency of an age cohort in PISA is a reasonably good predictor of the cohort's subsequent performance in literacy and numeracy as it moves through post-compulsory education and into the labour market.

STRUCTURE OF THIS REPORT

The purpose of this report is to situate the performance of 15-year-olds in the United States in PISA against the global patterns and trends. But it aims to go beyond the aggregate-level analysis that has so far been published in the PISA 2012 international reports, to give an analysis of student performance on individual mathematics test items in order to reveal students' strengths and weaknesses. Considering this also in the context of the relationship between PISA and the Common Core State Standards for Mathematics (CCSSM) can help connect these results to what the United States aspires to teach in classrooms and help inform teaching practices that can support performance improvement.

The remainder of this introductory chapter gives a brief account of what PISA is, its approach and what it measures. Chapter 2 provides an in-depth analysis of the performance of the United States on PISA, contrasting the performance of United States' 15-year-olds in mathematics, reading and science with that of students in other countries and the factors associated with quality and equity of outcomes.

Chapter 3 then looks in more detail at the strengths and weaknesses of students in the United States in the PISA 2012 mathematics assessment. This is done by examining the success rates of students at the item level of the test, compared with the success rates of students across OECD countries on average and in comparison with five comparator or reference systems. The five countries chosen for comparisons with the United States are: two top-performing Asian countries, Shanghai-China and Korea, two European countries performing significantly above the OECD average, the Netherlands and Germany, and one of United States' neighboring countries, Canada.

The final chapter examines the extent to which the PISA mathematics assessment relates to the the United States Common Core State Standards for Mathematics that a number of its states have adopted. It asks whether faithful implementation of the Common Core State Standards is likely to improve the United States' performance on PISA. The chapter provides an initial investigation into this by seeking to understand, in mathematical terms, how CCSSM relates to the PISA measures and vice versa.



WHAT IS PISA?

“What is important for citizens to know and be able to do?” That is the question that underlies the triennial survey of 15-year-old students around the world known as the Programme for International Student Assessment (PISA). PISA assesses the extent to which students near the end of compulsory education have acquired the key knowledge and skills that are essential for full participation in modern societies. The assessment, which focuses on reading, mathematics, science and problem solving, does not just ascertain whether students can reproduce knowledge; it also examines how well students can extrapolate from what they have learned and apply that knowledge in unfamiliar settings, both in and outside of school. This approach reflects the fact that modern economies reward individuals not for what they know, but for what they can do with what they know.

PISA is an ongoing program that offers insights for education policy and practice, and that helps monitor trends in students’ acquisition of knowledge and skills across countries and in different demographic subgroups within each country. PISA results reveal what is possible in education by showing what students in the highest-performing and most rapidly improving education systems can do. The findings allow policy makers around the world to gauge the knowledge and skills of students in their own countries in comparison with those in other countries, set policy targets against measurable goals achieved by other education systems, and learn from policies and practices applied elsewhere. While PISA cannot identify cause-and-effect relationships between policies/practices and student outcomes, it can show educators, policy makers and the interested public how education systems are similar and different – and what that means for students.

PISA’s unique features include its:

- **policy orientation**, which links data on student learning outcomes with data on students’ backgrounds and attitudes towards learning and on key factors that shape their learning, in and outside of school, in order to highlight differences in performance and identify the characteristics of students, schools and education systems that perform well;
- **innovative concept of “literacy”**, which refers to students’ capacity to apply knowledge and skills in key subjects, and to analyse, reason and communicate effectively as they identify, interpret and solve problems in a variety of situations;
- **relevance to lifelong learning**, as PISA asks students to report on their motivation to learn, their beliefs about themselves, and their learning strategies;
- **regularity**, which enables countries to monitor their progress in meeting key learning objectives; and
- **breadth of coverage**, which, in PISA 2012, encompasses the 34 OECD member countries and 31 partner countries and economies.

WHAT DOES THE PISA 2012 SURVEY MEASURE?

The PISA 2012 survey focused on mathematics, with reading, science and problem solving as minor areas of assessment. For the first time, PISA 2012 also included an assessment of the financial literacy of young people, which was optional for countries.

For PISA, mathematics proficiency means the capacity of individuals to formulate, employ and interpret mathematics in a variety of contexts. The term describes the capacities of individuals to reason mathematically and use mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. Mathematics literacy is not an attribute that an individual either has or does not have; rather, it is a skill that can be developed over a lifetime.

The 2012 survey is the fifth round of assessments since PISA began in 2000, and the second, after the 2003 survey, that focused on mathematics. As such, PISA 2012 provides an opportunity to evaluate changes in student performance in mathematics since 2003, and to view those changes in the context of policies and other factors.

For the first time, PISA 2012 included an optional computer-based assessment of mathematics. Specially-designed PISA questions are presented on a computer, and students respond on the computer, although they can also use pencil and paper as they think through the test questions.



Box 1.1 A test the whole world can take

PISA is now used as an assessment tool in many regions around the world. It was implemented in 43 countries and economies in the first assessment (32 in 2000 and 11 in 2002), 41 in the second assessment (2003), 57 in the third assessment (2006) and 75 in the fourth assessment (65 in 2009 and 10 in 2010). So far, 65 countries and economies have participated in PISA 2012.

In addition to OECD member countries, the survey has been or is being conducted in:

East and Southeast Asia: Himachal Pradesh-India, Hong Kong-China, Indonesia, Macao-China, Malaysia, Shanghai-China, Singapore, Chinese Taipei, Tamil Nadu-India, Thailand and Viet Nam.

Central, Mediterranean and Eastern Europe, and Central Asia: Albania, Azerbaijan, Bulgaria, Croatia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Liechtenstein, Lithuania, the Former Yugoslav Republic of Macedonia, Malta, Moldova, Montenegro, Romania, the Russian Federation and Serbia.

The Middle East: Jordan, Qatar and the United Arab Emirates.

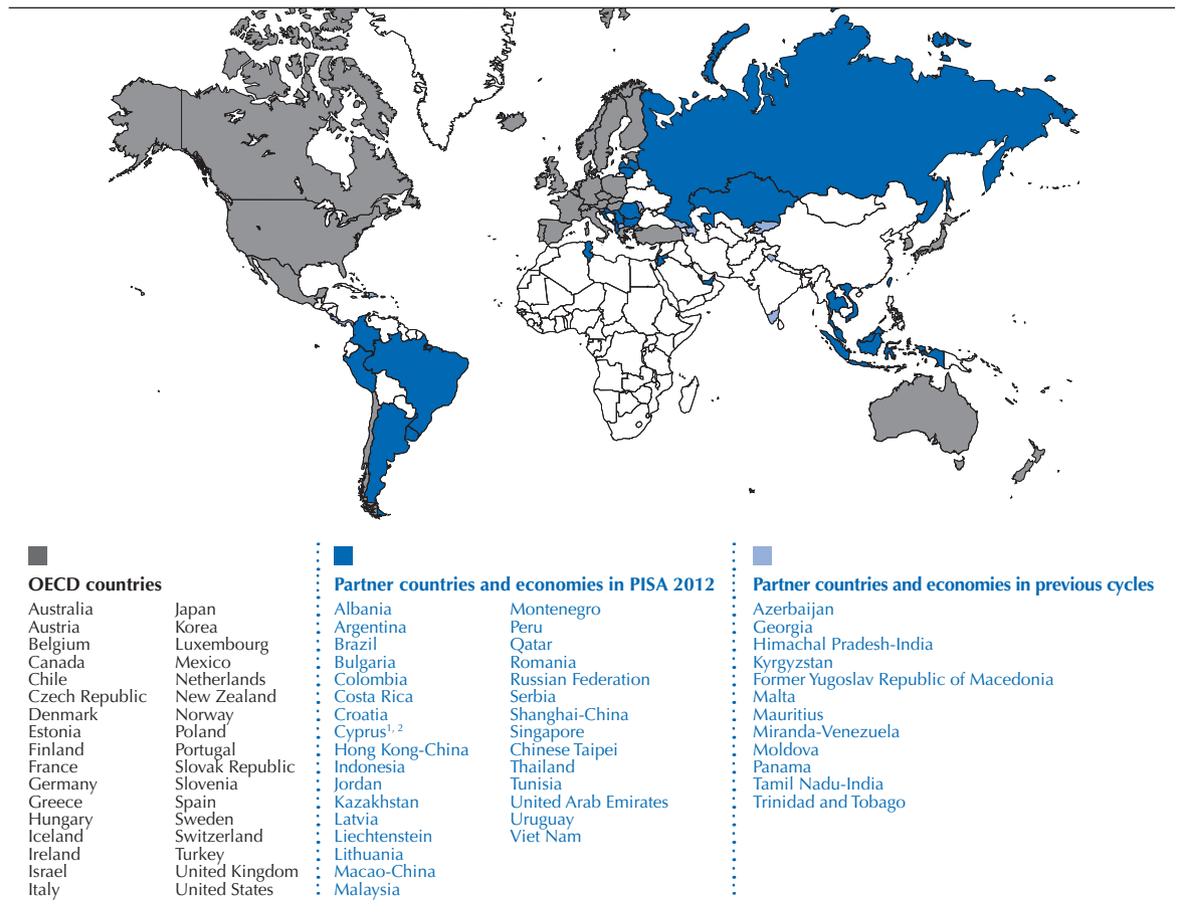
Central and South America: Argentina, Brazil, Colombia, Costa Rica, Netherlands-Antilles, Panama, Peru, Trinidad and Tobago, Uruguay and Miranda-Venezuela.

Africa: Mauritius and Tunisia.

Decisions about the scope and nature of the PISA assessments and the background information to be collected are made by leading experts in participating countries. Considerable efforts and resources are devoted to achieving cultural and linguistic breadth and balance in assessment materials. Since the design and translation of the test, as well as sampling and data collection, are subject to strict quality controls, PISA findings are considered to be highly valid and reliable.

■ Figure 1.1 ■

Map of PISA 2012 countries and economies





Box 1.2 Key features of PISA 2012

The content

- The PISA 2012 survey focused on mathematics, with reading, science and problem solving as minor areas of assessment. For the first time, PISA 2012 also included an assessment of the financial literacy of young people, which was optional for countries.
- PISA assesses not only whether students can reproduce knowledge, but also whether they can extrapolate from what they have learned and apply their knowledge in new situations. It emphasises the mastery of processes, the understanding of concepts, and the ability to function in various types of situations.

The students

- Around 510 000 students completed the assessment in 2012, representing about 28 million 15-year-olds in the schools of the 65 participating countries and economies.

The assessment

- Paper-based tests were used, with assessments lasting a total of two hours for each student. In a range of countries and economies, an additional 40 minutes were devoted to the computer-based assessment of mathematics, reading and problem solving.
- Test items were a mixture of multiple-choice items and questions requiring students to construct their own responses. The items were organised in groups based on a passage setting out a real-life situation. A total of about 390 minutes of test items were covered, with different students taking different combinations of test items.
- Students answered a background questionnaire, which took 30 minutes to complete, that sought information about themselves, their homes, and their school and learning experiences. School principals were also given a 30-minute questionnaire that covered the school system and the learning environment. In some countries and economies, optional questionnaires were distributed to parents, who were asked to provide information on their perceptions of and involvement in their child's school, their support for learning in the home, and their child's career expectations, particularly in mathematics. Countries could choose two other optional questionnaires for students: one asked students about their familiarity with and use of information and communication technologies, and the second sought information about their education to date, including any interruptions in their schooling and whether and how they are preparing for a future career.

REPORTING RESULTS FROM PISA 2012

The results of PISA 2012 are presented in six volumes.

Volume I, *What Students Know and can Do: Student Performance in Mathematics, Reading and Science* summarises student performance in mathematics in PISA 2012 and examines how that performance has changed over previous PISA assessments and examines how opportunities to learn are associated with mathematics performance. It also provides an overview of student performance in reading and science, and describes the evolution of performance in these subjects over previous PISA assessments.

Volume II, *Excellence through Equity: Giving Every Student the Chance to Succeed*, defines and measures equity in education and analyses how equity in education has evolved across countries between PISA 2003 and 2012. The volume examines the relationship between student performance and socio-economic status, and describes how other individual student characteristics, such as immigrant background and family structure, and school characteristics, such as school location, are associated with socio-economic status and performance. The volume also reveals differences in how equitably countries allocate resources and opportunities to learn to schools with different socio-economic profiles. Case studies, examining the policy reforms adopted by countries that have improved in PISA, are highlighted throughout the volume.

Volume III, *Ready to Learn: Student Engagement, Drive and Self-Beliefs*, explores students' engagement with and at school, their drive and motivation to succeed, and the beliefs they hold about themselves as mathematics learners. The volume identifies the students who are at particular risk of having low levels of engagement in, and holding negative dispositions towards, school in general and mathematics in particular, and how engagement, drive, motivation and self-beliefs are related to mathematics performance. The volume identifies the roles schools can play in shaping the well-being of students and the role parents can play in promoting their children's engagement with and dispositions



towards learning. Changes in students' engagement, drive, motivation and self-beliefs between 2003 and 2012, and how those dispositions have changed during the period among particular subgroups of students, notably socio-economically advantaged and disadvantaged students, boys and girls, and students at different levels of mathematics proficiency, are examined when comparable data is available. Throughout the volume, case studies examine in greater detail the policy reforms adopted by countries that have improved in PISA.

Volume IV, *What Makes Schools Successful? Resources, Policies and Practices*, examines how student performance is associated with various characteristics of individual schools and of concerned school systems. It discusses how 15-year-old students are selected and grouped into different schools, programs, and education levels, and how human, financial, educational and time resources are allocated to different schools. The volume also examines how school systems balance autonomy with collaboration, and how the learning environment in school shapes student performance. Trends in these variables between 2003 and 2012 are examined when comparable data is available, and case studies, examining the policy reforms adopted by countries that have improved in PISA, are highlighted throughout the volume.

Volume V, *Skills for Life: Student Performance in Problem Solving*, presents student performance in the PISA 2012 assessment of problem solving, which measures students' capacity to respond to non-routine situations in order to achieve their potential as constructive and reflective citizens. It provides the rationale for assessing problem-solving skills and describes performance within and across countries. In addition, the volume highlights the relative strengths and weaknesses of each school system and examines how they are related to individual student characteristics, such as gender, immigrant background and socio-economic status. The volume also explores the role of education in fostering problem-solving skills.

Volume VI, *Students and Money: Financial Literacy Skills for the 21st Century*, examines 15-year-old students' performance in financial literacy in the 18 countries and economies that participated in this optional assessment. It also discusses the relationship of financial literacy to students' and their families' background and to students' mathematics and reading skills. The volume also explores students' access to money and their experience with financial matters. In addition, it provides an overview of the current status of financial education in schools and highlights relevant case studies.

The frameworks for assessing mathematics, reading and science in 2012 are described in *PISA 2012 Assessment and Analytical Framework: Mathematics, Reading, Science, Problem Solving and Financial Literacy* (OECD, 2013).

Notes

1. Note by Turkey: The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

2. Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

Source: OECD, PISA 2012 Database.

Reference

OECD (2013a), *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*, OECD Publishing, Paris.