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# What is PISA?



“What is important for citizens to know and be able to do?” In response to that question and to the need for cross-nationally comparable evidence on student performance, the Organisation for Economic Co-operation and Development (OECD) launched the Programme for International Student Assessment (PISA) in 1997. PISA assesses the extent to which 15-year-old students, near the end of their compulsory education, have acquired key knowledge and skills that are essential for full participation in modern societies.

The triennial assessment focuses on the core school subjects of science, reading and mathematics. Students’ proficiency in an innovative domain is also assessed (in 2015, this domain is collaborative problem solving). The assessment does not just ascertain whether students can reproduce knowledge; it also examines how well students can extrapolate from what they have learned and can 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 programme that, over the longer term, will lead to the development of a body of information for monitoring trends in the knowledge and skills of students in various countries as well as in different demographic subgroups of each country. In each round of PISA, one of the core domains is tested in detail, taking up nearly two-thirds of the total testing time. The major domain in 2015 is science, as it was in 2006. Reading was the major domain in 2000 and 2009, and mathematics was the major domain in 2003 and 2012.

Through questionnaires distributed to students, parents, school principals and teachers, PISA also gathers information about students’ home background, their approaches to learning and their learning environments.

With this alternating schedule of major domains, a thorough analysis of achievement in each of the three core areas is presented every nine years; an analysis of trends is offered every three years. Combined with the information gathered through the various questionnaires, the PISA assessment provides three main types of outcomes:

- Basic indicators that provide a baseline profile of the knowledge and skills of students.
- Indicators derived from the questionnaires that show how such skills relate to various demographic, social, economic and educational variables.
- Indicators on trends that show changes in outcome levels and distributions, and in relationships between student-level, school-level and system-level background variables and outcomes.

Policy makers around the world use PISA findings to gauge the knowledge and skills of students in their own country/economy in comparison with those in other participating countries/economies, establish benchmarks for improvements in the education provided and/or in learning outcomes, and understand the relative strengths and weaknesses of their own education systems.

This publication presents the theory underlying the PISA 2015 assessment – the sixth since the programme’s inception. It includes frameworks for assessing the three core subjects – science, reading and mathematics (Chapters 2, 3 and 4, respectively) – and the framework for an assessment of students’ financial literacy (Chapter 5). This revised edition includes the framework for assessing collaborative problem solving, outlined in Chapter 7. The chapters outline the knowledge content that students need to acquire in each domain, the processes that students need to be able to perform, and the contexts in which this knowledge and these skills are applied. They also discuss how each domain is assessed. Chapter 6 explains the theory underlying the context questionnaires distributed to students, their parents, school principals and teachers.

## WHAT MAKES PISA UNIQUE

PISA is the most comprehensive and rigorous international programme to assess student performance and to collect data on the student, family and institutional factors that can help to explain differences in performance. Decisions about the scope and nature of the assessments and the background information to be collected are made by leading experts in participating countries, and are steered jointly by governments on the basis of shared, policy-driven interests. Substantial efforts and resources are devoted to achieving cultural and linguistic breadth and balance in the assessment materials. Stringent quality-assurance mechanisms are applied in translation, sampling and data collection. As a consequence, the results of PISA have a high degree of validity and reliability.



PISA's unique features include its:

- **Policy orientation**, which connects 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 school, in order to highlight differences in performance patterns and identify the characteristics of 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.
- **Breadth of coverage**, which, in PISA 2015, encompasses the 34 OECD countries and 38 partner countries and economies.

### Box 1.1 Key features of PISA 2015

#### The content

The PISA 2015 survey focused on science, with reading, mathematics and collaborative problem solving as minor areas of assessment. PISA 2015 also included an assessment of young people's financial literacy, which was optional for countries and economies.

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

Approximately 540 000 students completed the assessment in 2015, representing about 29 million 15-year-olds in the schools of the 72 participating countries and economies.

#### The assessment

Computer-based tests were used, with assessments lasting a total of two hours for each student, in a range of countries and economies.

Test items were a mixture of multiple-choice questions 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. About 810 minutes of test items for science, reading, mathematics and collaborative problem solving were covered, with different students taking different combinations of test items.

Students also answered a background questionnaire, which took 35 minutes to complete. The questionnaire sought information about the students themselves, their homes, and the school and learning experiences. School principals completed a questionnaire that covered the school system and the learning environment. For additional information, some countries/economies decided to distribute a questionnaire to their teachers. It was the first time that this optional teacher questionnaire was offered to PISA-participating countries/economies. In some countries/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 science. Countries could choose two other optional questionnaires for students: one asked students about their familiarity with and use of information and communication technologies (ICT); 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.

The relevance of PISA results is confirmed by studies tracking young people in the years following the assessment. Studies in Australia, Canada and Denmark show a strong relationship between 15-year-old students' performance in reading in the PISA 2000 assessment and the likelihood of a student completing secondary school and continuing with post-secondary studies at age of 19. For example, Canadian students who had attained reading proficiency Level 5 at the age of 15 were 16 times more likely to be enrolled in post-secondary studies when they were 19 years old than those who had not attained Level 1 in reading proficiency.



## THE PISA 2015 TEST

For the first time, PISA 2015 delivers the assessments of all subjects via computer. Paper-based assessment instruments were provided for countries that choose not to test their students by computer, but the paper-based assessment was limited to reading, mathematics and science trends items only. New items were developed only for the computer-based assessment. A field trial was used to study the effect of the change of mode of delivery. Data were collected and analysed to establish equivalence between the computer- and paper-based assessments.

### Box 1.2 2015 mode study

A study similar to the mode study for the OECD Programme for the International Assessment of Adult Competencies (PIAAC) was planned for the PISA 2015 field trial. Students were randomly assigned to either a computer-based or paper-based assessment of reading, mathematical and scientific literacy. Each domain included six clusters of paper-based trend items that were used in previous cycles of PISA. These items were adapted for computer delivery so that countries opting to take the computer-based assessment would be able to link back to previous cycles and would be comparable with countries choosing the paper-based option. Some two-thirds of the items from PISA use objective scoring, such as multiple-choice, true false, and simple open-ended response formats that are easily adapted and reliably scored by computer; the rest are scored by expert coders within each country. These more complex open-ended items were retained and scored in a similar fashion for PISA 2015. Analyses of the PISA field trial were used to determine the comparability between the two modes of presentation across all trend items. Results were presented to and agreed with the PISA Technical Advisory Group, the OECD and all participating countries in 2014.

The 2015 computer-based assessment was designed as a two-hour test. Each test form allocated to students comprised four 30-minute clusters of test material. This test design included six intact clusters from each of the domains of science, reading and mathematics to measure trends. For the major subject of science, an additional six clusters of items were developed to reflect the new features of the 2015 framework. In addition, three clusters of collaborative problem-solving items were developed for the countries that decided to participate in this assessment.

There were 66 different test forms. Students spent one hour on the science assessment (one cluster each of trends and new science items) plus one hour on another subject – reading, mathematics or collaborative problem solving. For the countries/economies that chose not to participate in the collaborative problem-solving assessment, 36 test forms were prepared.

Countries that chose paper-based delivery for the main survey measured student performance with 30 paper-and-pencil forms containing trends items from two of the three core PISA domains.

Each test form was completed by a sufficient number of students for appropriate estimates to be made of the achievement levels on all items by students in each country and in relevant subgroups within a country (such as boys and girls, and students from different social and economic contexts).

The assessment of financial literacy is offered as an option in PISA 2015 based on the same framework as the one developed for PISA 2012. The financial literacy assessment was developed as a one-hour exercise, comprising two clusters distributed to a subsample of students in combination with the science, mathematics and reading assessments.

## AN OVERVIEW OF WHAT IS ASSESSED IN EACH DOMAIN

Box 1.3 presents definitions of the three core domains assessed in PISA 2015. The definitions all emphasise functional knowledge and skills that allow one to participate fully in society. Such participation requires more than just being able to carry out tasks imposed externally by, for example, an employer; it also means being able to participate in decision making. The more complex tasks in PISA require students to reflect on and evaluate material, not just to answer questions that have one correct answer.



### Box 1.3 Definitions of the domains

**Scientific literacy:** The ability to engage with science-related issues, and with the ideas of science, as a reflective citizen. A scientifically literate person is willing to engage in reasoned discourse about science and technology, which requires the competencies to:

- Explain phenomena scientifically – recognise, offer and evaluate explanations for a range of natural and technological phenomena.
- Evaluate and design scientific enquiry – describe and appraise scientific investigations and propose ways of addressing questions scientifically.
- Interpret data and evidence scientifically – analyse and evaluate data, claims and arguments in a variety of representations and draw appropriate scientific conclusions.

**Reading literacy:** An individual's capacity to understand, use, reflect on and engage with written texts, in order to achieve one's goals, to develop one's knowledge and potential, and to participate in society.

**Mathematical literacy:** An individual's capacity to formulate, employ and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to recognise the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens.

**Scientific literacy** (Chapter 2) is defined as the ability to engage with science-related issues, and with the ideas of science, as a reflective citizen. A scientifically literate person is willing to engage in reasoned discourse about science and technology, which requires the competencies to explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically.

PISA assesses students' performance in science through questions related to:

Contexts: Personal, local/national and global issues, both current and historical, which demand some understanding of science and technology. The contexts in PISA 2015 were changed from "personal, social and global" in the 2006 assessment to "personal, local/national and global" to make the headings more coherent.

Knowledge: An understanding of the major facts, concepts and explanatory theories that form the basis of scientific knowledge. Such knowledge includes knowledge of both the natural world and technological artefacts (content knowledge), knowledge of how such ideas are produced (procedural knowledge), and an understanding of the underlying rationale for these procedures and the justification for their use (epistemic knowledge). The major difference from PISA 2006 is that the notion of "knowledge about science" has been specified more clearly and split into two components: procedural knowledge and epistemic knowledge.

Competencies: The ability to explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically.

Attitudes: A set of attitudes towards science indicated by an interest in science and technology, valuing scientific approaches to enquiry, where appropriate, and a perception and awareness of environmental issues. The second, "support for scientific enquiry" in the previous cycles, was changed to a measure of "valuing scientific approaches to enquiry", which is essentially a change in terminology to better reflect what is measured.

**Reading literacy** (Chapter 3) is defined as students' ability to understand, use and reflect on written text to achieve their purposes.

PISA assesses students' performance in reading through questions related to:

Text format: PISA uses continuous texts or prose organised in sentences and paragraphs, and non-continuous texts that present information in other ways, such as in lists, forms, graphs or diagrams. The test uses a range of prose forms, such as narration, exposition and argumentation.



**Processes (aspects):** Students are not assessed on the most basic reading skills, as it is assumed that most 15-year-old students will have acquired these. Rather, students are expected to demonstrate their proficiency in accessing and retrieving information, forming a broad general understanding of the text, interpreting it, reflecting on its content, and reflecting on its form and features.

**Situations:** These are defined by the use for which the text was constructed. For example, a novel, personal letter or biography is written for people's personal use; official documents or announcements for public use; a manual or report for occupational use; and a textbook or worksheet for educational use. Since some groups may perform better in one reading situation than in another, a range of types of reading is included in the test.

**Mathematical literacy** (Chapter 4) is defined as students' ability to analyse, reason and communicate ideas effectively as they pose, formulate, solve and interpret solutions to mathematical problems in a variety of situations.

PISA assesses students' performance in mathematics through questions related to:

**Processes:** These are defined in terms of three categories: formulating situations mathematically; employing mathematical concepts, facts, procedures and reasoning; and interpreting, applying and evaluating mathematical outcomes (herein referred to as "formulate", "employ" and "interpret"). They describe what students do to connect the context of a problem with the mathematics involved and thus solve the problem. These three processes each draw on seven fundamental mathematical capabilities: communicating; mathematising; representing; reasoning and argument; devising strategies for solving problems; using symbolic, formal and technical language and operations; and using mathematical tools. All of these capabilities are based on the problem solver's detailed mathematical knowledge about individual topics.

**Content:** These are four ideas (quantity, space and shape, change and relationships, and uncertainty and data) that are related to familiar curricular subjects, such as numbers, algebra and geometry, in overlapping and complex ways.

**Contexts:** These are the settings in a student's world in which the problems are placed. The framework identifies four contexts: personal, educational, societal and scientific.

## THE EVOLUTION OF REPORTING STUDENT PERFORMANCE IN PISA

Results from PISA are reported using scales. Initially, the OECD average score for all three subjects was 500 with a standard deviation of 100, which meant that two-thirds of students across OECD countries scored between 400 and 600 points. These scores represent degrees of proficiency in a particular domain. In subsequent cycles of PISA, the OECD average score has fluctuated slightly around the original.

Reading literacy was the major domain in 2000, and the reading scales were divided into five levels of knowledge and skills. The main advantage of this approach is that it is useful for describing what substantial numbers of students can do with tasks at different levels of difficulty. Results were also presented through three "aspect" subscales of reading: accessing and retrieving information; integrating and interpreting texts; and reflecting and evaluating texts. A proficiency scale was also available for mathematics and science, though without described levels.

PISA 2003 built upon this approach by specifying six proficiency levels for the mathematics scale. There were four "content" subscales in mathematics: space and shape, change and relationships, quantity, and uncertainty.

Similarly, the reporting of science in PISA 2006 specified six proficiency levels. The three "competency" subscales in science related to identifying scientific issues, explaining phenomena scientifically and using scientific evidence. Country performance was compared on the bases of knowledge about science and knowledge of science. The three main areas of knowledge of science were physical systems, living systems, and earth and space systems.

PISA 2009 marked the first time that reading literacy was re-assessed as a major domain. Trend results were reported for all three domains. PISA 2009 added a Level 6 to the reading scale to describe very high levels of reading proficiency. The bottom level of proficiency, Level 1, was relabelled as Level 1a. Another level, Level 1b, was introduced to describe the performance of students who would previously have been rated as "below Level 1", but who show proficiency in relation to new items that are easier than those included in previous PISA assessments. These changes allow countries to know more about what kinds of tasks students with very high and very low reading proficiency are capable of completing.



Mathematics was re-assessed as a major domain in PISA 2012. In addition to the “content” subscales (with the “uncertainty” scale re-named as “uncertainty and data” for improved clarity), three new subscales were developed to assess the three processes in which students, as active problem solvers, engage. These three “process” subscales are: formulating situations mathematically; employing mathematical concepts, facts, procedures and reasoning; and interpreting, applying and evaluating mathematical outcomes (known as “formulating”, “employing” and “interpreting”).

Science, which was the main subject of assessment in PISA 2006, is again the main domain in PISA 2015. The assessment measures students’ ability to: explain phenomena scientifically; evaluate and design scientific enquiry; and interpret data and evidence scientifically. The science scale has also been extended by the addition of a Level “1b” to better describe the proficiency of students at the lowest level of ability who demonstrate minimal scientific literacy and who would previously not have been included in the reporting scales.

## THE CONTEXT QUESTIONNAIRES

To gather contextual information, PISA asks students and the principals of their schools to respond to questionnaires. These take about 35 and 45 minutes, respectively, to complete. The responses to the questionnaires are analysed with the assessment results to provide at once a broader and more nuanced picture of student, school and system performance. Chapter 6 presents the questionnaire framework in detail. The questionnaires from all assessments since PISA’s inception are available on the PISA website: [www.pisa.oecd.org](http://www.pisa.oecd.org).

The questionnaires seek information about:

- Students and their family backgrounds, including their economic, social and cultural capital.
- Aspects of students’ lives, such as their attitudes towards learning, their habits and life in and outside of school, and their family environment.
- Aspects of schools, such as the quality of the schools’ human and material resources, public and private management and funding, decision-making processes, staffing practices and the school’s curricular emphasis and extracurricular activities offered.
- Context of instruction, including institutional structures and types, class size, classroom and school climate, and science activities in class.
- Aspects of learning, including students’ interest, motivation and engagement.

Four additional questionnaires are offered as options:

- A *computer familiarity questionnaire*, focusing on the availability and use of information and communications technology (ICT) and on students’ ability to carry out computer tasks and their attitudes towards computer use.
- An *educational career questionnaire*, which collects additional information on interruptions in schooling, on preparation for students’ future career, and on support with science learning.
- A *parent questionnaire*, focusing on parents’ perceptions of and involvement in their child’s school, their support for learning at home, school choice, their child’s career expectations, and their background (immigrant/non-immigrant).
- A *teacher questionnaire*, which is new to PISA, will help illustrate the similarities and differences between groups of teachers in order to better establish the context for students’ test results. The level of analysis of data gathered from the optional teacher questionnaire is the school level. Science teachers are asked to describe their teaching practices through a parallel questionnaire that also focuses on teacher-directed teaching and learning activities in science lessons, and a selected set of inquiry-based activities. The teacher questionnaire asks about the content of a school’s science curriculum and how it is communicated to parents too. The new optional teacher questionnaire gathers information on transformational leadership as well.

The contextual information collected through the student, school and optional questionnaires comprises only a part of the information available to PISA. Indicators describing the general structure of the education systems (their demographic and economic contexts – for example, costs, enrolments, school and teacher characteristics, and some classroom processes) and their effect on labour market outcomes are routinely developed and applied by the OECD (e.g. in the annual OECD publication, *Education at a Glance*).



## A COLLABORATIVE PROJECT

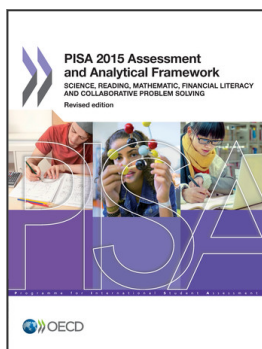
PISA is the result of a collaborative effort among OECD and partner governments. The assessments are developed co-operatively, agreed by participating countries/economies, and implemented by national organisations. The co-operation of students, teachers and principals in participating schools has been crucial to the success of PISA during all stages of development and implementation.

The PISA Governing Board (PGB), representing all countries/economies at senior policy levels, determines the policy priorities for PISA in the context of OECD objectives and oversees adherence to these priorities during the implementation of the programme. The PGB sets priorities for developing indicators, for establishing assessment instruments and for reporting results. Experts from participating countries/economies also serve on working groups tasked with linking PISA policy objectives with the best available technical expertise in the different assessment domains. By participating in these expert groups, countries/economies ensure that the instruments are internationally valid and take into account differences in the cultures and education systems.

Participating countries/economies implement PISA at the national level, through National Centres managed by National Project Managers, subject to the agreed administration procedures. National Project Managers play a vital role in ensuring that implementation is of high quality. They also verify and evaluate the survey results, analyses, reports and publications.

The development of the science and collaborative problem-solving frameworks and the adaptation of the frameworks for reading and mathematics are the responsibility of Pearson, while the design and development of the questionnaires are the responsibility of the Deutsches Institut für Pädagogische Forschung (DIPF). Management and oversight of this survey, the development of the instruments, scaling, and analysis are the responsibility of the Educational Testing Service (ETS) as is the development of the electronic platform. Other partners or subcontractors involved with ETS include cApStAn Linguistic Quality Control and the Department of Experimental and Theoretical Pedagogy at the University of Liège (SPe) in Belgium; the Center for Educational Technology (CET) in Israel; the Public Research Centre (CRP) Henri Tudor and the Educational Measurement and Research Center (EMACS) of the University of Luxembourg in Luxembourg; and GESIS – Leibniz-Institute for the Social Sciences in Germany. Westat assumed responsibility for survey operations and sampling with the subcontractor, the Australian Council for Educational Research (ACER).

The OECD Secretariat has overall managerial responsibility for the programme, monitors its implementation on a day-to-day basis, acts as the secretariat for the PGB, builds consensus among countries, and serves as the interlocutor between the PGB and the contractors charged with implementation. The OECD Secretariat is also responsible for the production of the indicators, and the analysis and preparation of the international reports and publications in co-operation with the contractors and in close consultation with member countries both at the policy level (PGB) and at the implementation level (National Project Managers).



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