



PROGRAMME FOR INTERNATIONAL
STUDENT ASSESSMENT (PISA)
RESULTS FROM PISA 2012 PROBLEM SOLVING

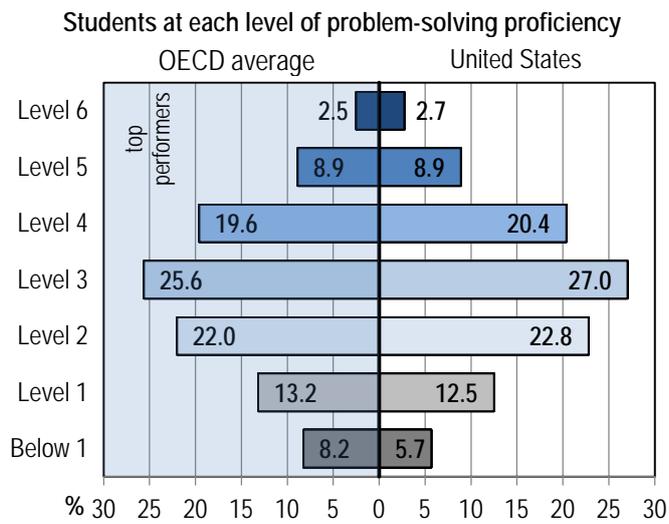
United States

In recent decades, there has been a marked increase in the share of jobs that require creative problem-solving skills. Fifteen-year-olds who lack these skills today thus face a high risk of economic disadvantage as adults. They will compete for jobs that are becoming rare; and if they are unable to adapt to new circumstances and learn in unfamiliar contexts, they may find it particularly difficult to move to better jobs as economic and technological conditions evolve. PISA's first assessment of creative problem-solving skills shows how well-prepared students are to confront – and solve – the kinds of problems that are encountered almost daily in 21st century life.

- With a mean score of 508 points in problem solving, students in the United States perform slightly above the average (500 points) of the 28 OECD countries that took part in the assessment.
- In the United States, students perform significantly better in problem solving, on average, than students in other countries who show similar performance in mathematics, reading and science. This is particularly true among strong performers in mathematics, which suggests that these students, in particular, have access to learning opportunities that prepare them well for handling complex, real-life problems in contexts that they do not usually encounter at school.
- Fifteen-year-olds in the United States perform strongest on interactive tasks, compared to students of similar overall performance in other countries. Interactive tasks require students to uncover some of the information needed to solve the problem themselves. This suggests that students in the United States are open to novelty, tolerate doubt and uncertainty, and dare to use intuition to initiate a solution.
- Still, more than one in six students (18.2%) in the United States do not reach the baseline level of proficiency in problem solving – meaning that, at best, they are only able to solve very simple problems that do not require thinking ahead and that are cast in familiar settings, such as selecting the least-expensive models of furniture from a catalogue showing different brands and prices (Level 1 tasks). While this proportion is smaller than the OECD average (21.4%), in Japan and Korea only 7% of students perform below Level 2.
- The largest achievement gap in problem solving between the United States and the highest-performing Asian countries is found on tasks where students must select, organise and integrate the information and feedback received in order to represent and formulate their understanding of the problem.

PISA 2012 defines problem-solving competence as “...an individual's capacity to engage in cognitive processing to understand and resolve problem situations where a method of solution is not immediately obvious. It includes the willingness to engage with such situations in order to achieve one's potential as a constructive and reflective citizen”. The problem-solving assessment focuses on students' general reasoning skills, their ability to regulate problem-solving processes, and their willingness to do so, by confronting students with problems that do not require expert knowledge to solve – such as buying the best ticket that satisfies all constraints at an unfamiliar vending machine. In contrast, when the regular assessments of mathematics, reading and science in PISA include problem-solving tasks, solving these problems requires curricular knowledge in addition to problem-solving skills.

Performance in problem solving in the United States



Source: Table V.2.1

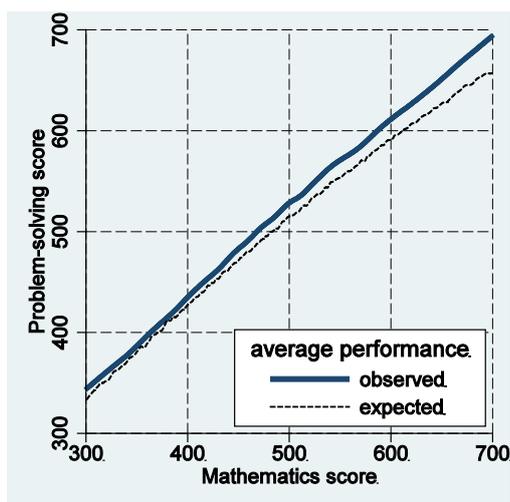
Mean performance in problem solving		Range of ranks
	Mean score	
Singapore	562	1 – 2
Korea	561	1 – 2
Japan	552	3
...		
Shanghai-China	536	4 – 7
Canada	526	8 – 10
Australia	523	8 – 11
Finland	523	8 – 11
England (United Kingdom)	517	9 – 16
France	511	11 – 19
Netherlands	511	11 – 21
Italy	510	12 – 21
Germany	509	12 – 21
United States	508	12 – 21
OECD average	500	

This table includes only a selection of participating countries and economies. For the complete ranking, see Figure V.2.4.

- Students in the United States perform above the average of the 28 OECD countries that assessed students' problem-solving skills in 2012. With an average score of 508 points, the rank of the United States among all 44 participating countries and economies is estimated to lie between ranks 12 and 21.
- Average performance in the United States is not significantly different from that in Austria, Belgium, the Czech Republic, Estonia, France, Germany, Ireland, Italy, the Netherlands, Norway and England (United Kingdom).

Relative performance in problem solving in the United States

Relative performance at different levels of the mathematics scale



Relative performance is defined as the difference between the observed score in problem solving and the expected score, based on performance in core subjects. Stronger-than-expected performance in problem solving may indicate that the learning opportunities available to students prepare them well for handling complex, real-life problems in contexts that they do not usually encounter at school. However, if it coincides with low performance overall, it may also indicate that students' potential is not realised in the core subjects.

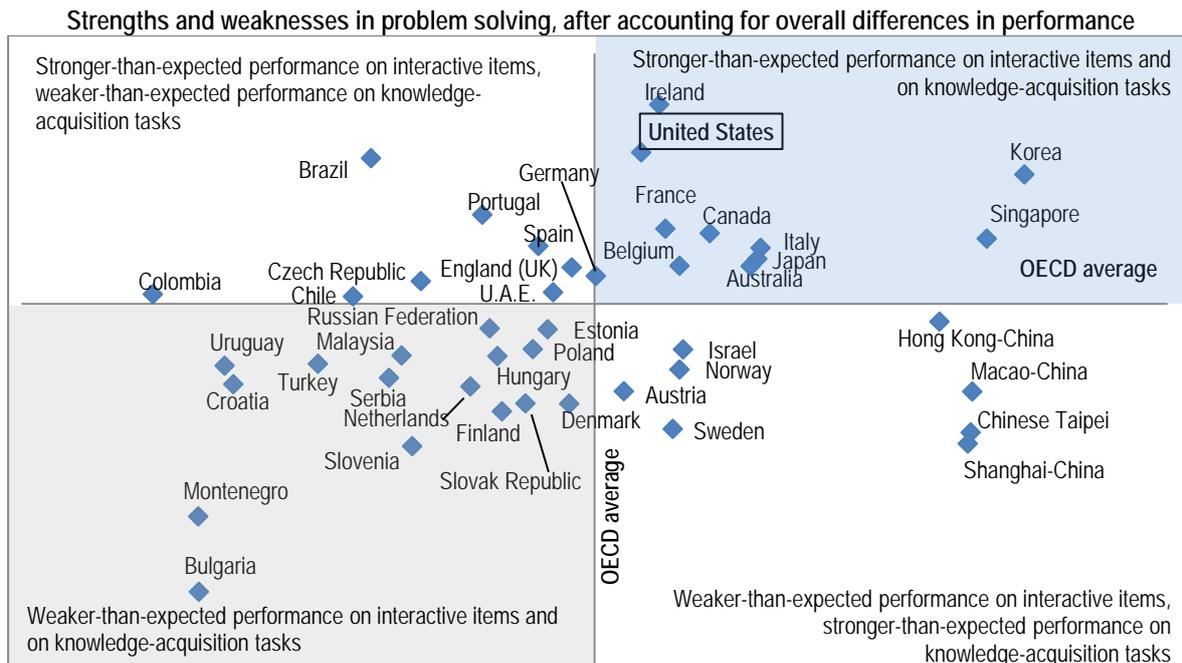
Relative performance in problem solving		Score dif.
Accounting for performance in all core subjects		
...among all students		10
Accounting for performance in mathematics only		
...among all students		13
...among strong and top performers in mathematics		20
...among moderate and low performers in mathematics		11

Note: Statistically significant differences are marked in bold. Source: Table V.2.6

- Students in the United States perform better than expected in problem solving, based on their performance in mathematics, reading and science. The difference between observed and expected performance is particularly large among students who perform at Level 4 and above.

Strengths and weaknesses in problem solving

- Students in the United States perform better than expected on interactive items, based on their success on static (non-interactive) tasks. Interactive items require students to uncover useful information by exploring the problem situation and gathering feedback on the effect of their actions. To do so, students need to be open to novelty, tolerate doubt and uncertainty, and dare to use intuitions to initiate a solution.
- Success rates on knowledge-acquisition and knowledge-utilisation tasks are in line with the OECD average, after accounting for overall success on the test. However, these rates are lower than those found in the best-performing countries in problem solving, which often do particularly well on knowledge-acquisition tasks that require advanced reasoning skills and self-directed learning.



Source: Figure V.3.10.

How performance in problem solving varies within the United States

Performance in problem solving by subgroup	
	Mean score/score dif.
Boys	509
Girls	506
Difference (Boys-Girls)	3
Immigrant students	498
Non-immigrant students	512
Difference (imm.– non-imm.)	-14
Strength of the relationship between socio-economic status and performance	
Performance variation accounted for by socio-economic status (%)	
Problem solving	10.1
Mathematics	14.8
Difference (PS - M)	-4.7

Statistically significant differences are marked in bold.

Source: Tables V.4.7, V.4.13, V.4.19

- In the United States, boys score at the same level as girls in problem solving, on average (the OECD average difference in favour of boys is 7 score points), but there are more boys than girls among the students performing at Level 5 or 6.
- Students with an immigrant background score significantly below non-immigrant students in the United States. However, they perform as expected based on their scores in mathematics, reading and science.
- The impact of socio-economic status on performance is significantly weaker in problem solving than in mathematics, both in the United States and across OECD countries, on average.

What is PISA?

The Programme for International Student Assessment (PISA) is a triennial survey that assesses the extent to which 15-year-old students near the end of compulsory education have acquired the knowledge and skills that are essential for full participation in modern societies. 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 apply that knowledge in unfamiliar settings, both in and outside of school.

PISA offers insights for education policy and practice, and helps monitor trends in students' acquisition of knowledge and skills across countries and in different demographic subgroups within each country. The findings allow policy makers 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.

Key features of the PISA 2012 assessment of problem solving

In 2012, more than 40 countries and economies participated in the assessment of problem solving. **OECD countries:** Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Japan, Korea, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Turkey, England (United Kingdom) and the United States. **Partner countries and economies:** Brazil, Bulgaria, Colombia, Croatia, Hong Kong-China, Macao-China, Malaysia, Montenegro, the Russian Federation, Serbia, Shanghai-China, Singapore, Chinese Taipei, the United Arab Emirates and Uruguay.

The assessment

- Problem solving was assessed on computers. The computer-based assessments lasted a total of 40 minutes, with different students taking different combinations of test items. A total of 80 minutes of problem-solving items were covered. Only basic computer familiarity and skills were required to complete the assessment.
- The use of computers made it possible to include interactive problems, in which students need to explore the (simulated) environment and gather feedback on the effect of their interventions in order to obtain all the information needed to solve a problem. Test questions were a mixture of multiple-choice questions and those requiring students to construct their own responses. Sample items can be explored online at www.oecd.org/pisa/test.
- Students assessed in problem solving also completed a two-hour assessment of mathematics, reading and science. They also answered a background questionnaire, which took 30 minutes to complete, that sought information about themselves, their homes and their school and learning experiences. In addition, countries could choose an optional questionnaire for students, asking about their familiarity with and use of information and communication technologies.

The students

- Only a subsample of all students assessed in mathematics, reading and science in 2012 also participated in the computer-based assessment of problem solving. Around 85 000 students were assessed in problem solving, representing about 19 million 15-year-olds in the schools of the 44 participating countries and economies.

In the United States, 1 273 students in 162 schools completed the assessment of problem solving.

Contacts:

Andreas Schleicher
Acting Director for Education and Skills
and Special Advisor on Education
Policy to the Secretary-General

Andreas.SCHLEICHER@oecd.org

Telephone: +33 6 07 38 54 64

Francesco Avvisati
Analyst
Directorate for Education and Skills

Francesco.AVVISATI@oecd.org

Telephone: +33 1 45 24 17 61

