



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

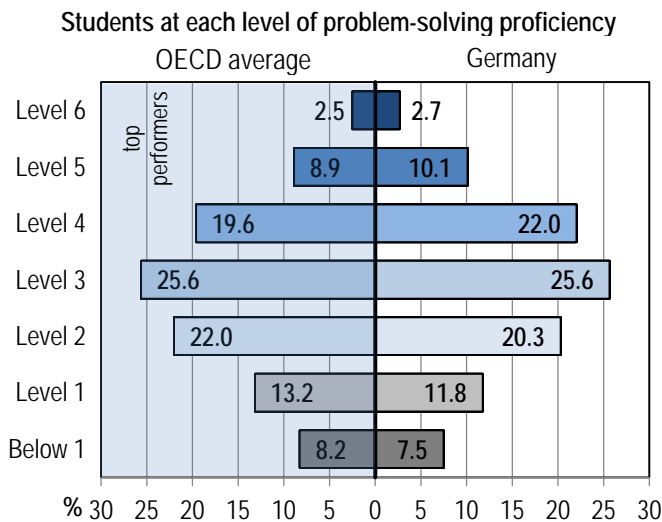
Germany

PISA's first computer-based assessment of 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.

- Germany's performance in problem solving is above the OECD average. However, German students perform below students in Australia, Canada, Finland and most East Asian countries and economies that participated in the assessment.
- About one in five students in Germany (19.2% - a proportion similar to the OECD average) does not reach the baseline level of proficiency in problem solving – meaning that, at best, they can only solve very simple problems that do not require to think 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). In Japan and Korea only 7% of students perform below Level 2.
- Overall, performance in problem solving in Germany is lower than expected, based on the skills demonstrated by students in mathematics, reading and science; this is particularly true among students with moderate and low performance in mathematics. In contrast, students who perform strongly in mathematics show similar proficiency in problem solving as students in other countries who also perform strongly in mathematics. These students often attend the education tracks that emphasise academic curricula (*Gymnasium*). This may indicate that academically weaker students are not given sufficient opportunities to learn the skills needed to solve complex, real-life problems in contexts that they do not usually encounter at school.
- In Germany, the impact of socio-economic status on problem-solving performance is significantly weaker than it is on mathematics performance – perhaps because after-school opportunities to exercise problem-solving skills arise in diverse social and cultural contexts. Still, the quality of schools matters: unequal access to high-quality schools means that disadvantaged students score below advantaged students, on average, in all subjects assessed, including problem solving.

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 Germany



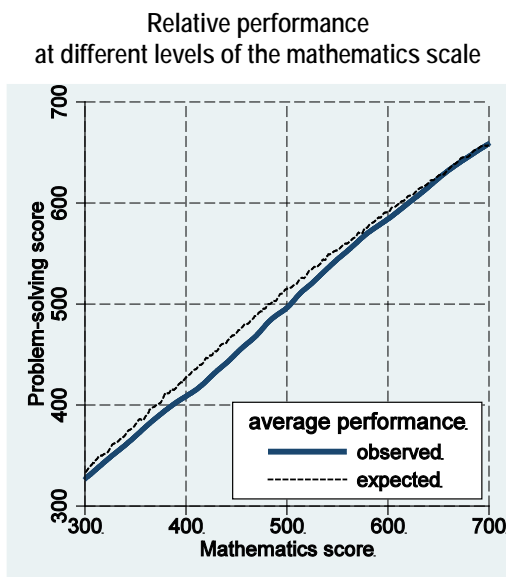
Source: Table V.2.1

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
Italy	510	12 – 21
Germany	509	12 – 21
United States	508	12 – 21
Austria	506	13-22
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 Germany perform above the average of the 28 OECD countries that assessed students' problem-solving skills in 2012. With a mean score of 509 points, the rank of Germany among all 44 participating countries and economies is estimated to lie between ranks 12 and 21.
- Average performance in Germany is not significantly different from average performance in Austria, Belgium, the Czech Republic, Estonia, France, Italy, the Netherlands, Norway, England (United Kingdom) and the United States.

Relative performance in problem solving in Germany



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.

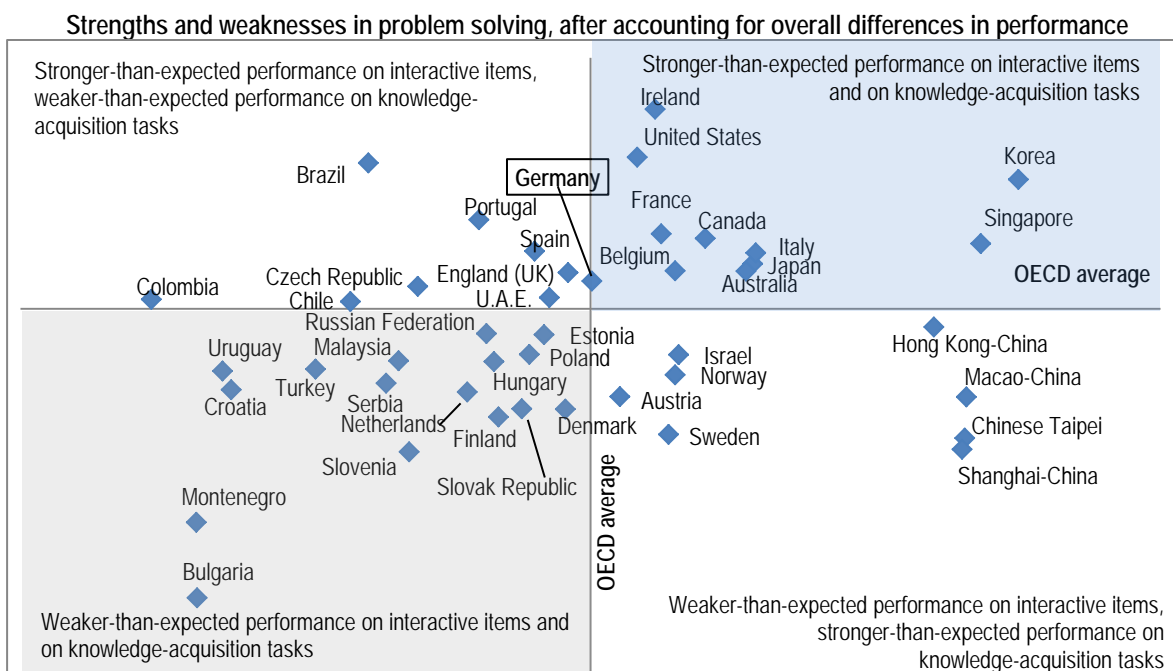
Relative performance in problem solving		Score dif.
Accounting for performance in all core subjects		
...among all students		-12
Accounting for performance in mathematics only		
...among all students		-12
...among strong and top performers in mathematics		-6
...among moderate and low performers in mathematics		-16

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

- Students in Germany perform lower 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 with moderate and low performance in mathematics.

Strengths and weaknesses in problem solving

- Students in Germany performed as expected on interactive items, based on their overall success. Interactive items require students to uncover useful information by exploring the problem situation and gathering feedback on the effect of their interventions. In order to reach a solution, students must 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 those found across OECD countries, on average, after accounting for overall success on the test. The best-performing countries in problem-solving often do particularly well on knowledge-acquisition tasks that require high levels of reasoning skills and self-directed learning.



Source: Figure V.3.10.

How performance in problem solving varies within Germany

Performance in problem solving by subgroup	
	Mean score/score dif.
Boys	512
Girls	505
Difference (Boys-Girls)	7
Immigrant students	473
Non-immigrant students	523
Difference (imm.- non-imm.)	-50
Strength of the relationship between socio-economic status and performance	
	Performance variation accounted for by socio-economic status (%)
Problem solving	12.7
Mathematics	16.9
Difference (PS - M)	-4.2

Statistically significant differences are marked in bold.

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

- In Germany, boys score significantly higher than girls in problem solving, on average (the OECD average difference in favour of boys is 7 score points). While there are equal proportions of girls and boys at lower levels of proficiency, the highest-performing students in problem solving are largely boys. As across OECD countries, on average, in Germany, there are about three boys for every two girls who perform at Level 5 or 6 in problem solving.
- Students with an immigrant background score significantly below non-immigrant students in Germany; however, they perform as expected based on their scores in mathematics, reading and science.
- In Germany as across OECD countries, on average, the impact of socio-economic status is significantly weaker on problem-solving performance than on mathematics performance.

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 <http://cbasq.acer.edu.au>.
- 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 Germany, 1 350 students in 230 schools completed the assessment of problem solving.

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