Equations and Inequalities: Making Mathematics Accessible to All

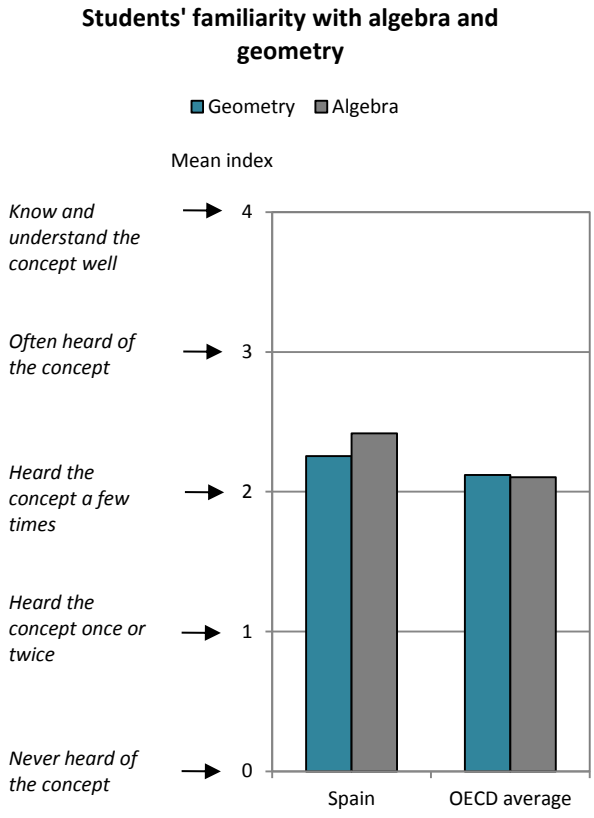
Country note Spain

Numeracy skills are used daily in many jobs, and proficiency in numeracy is important for a wide range of outcomes in adult life, from employment to health and civic participation. But proficiency in mathematics involves more than the ability to make simple calculations; people also need to be able to reason mathematically. Given the importance of mathematics reasoning in everything from preparing a meal to exploring space, mathematics curricula and teaching practices need to give all students the opportunity to develop higher-order thinking and reasoning skills.

Opportunity to learn (OTL) refers to the content taught in the classroom and the time a student spends learning this content. Not all students, not even those in the same school, have equal opportunities to learn. Opportunity to learn can be affected not only by the content of the curriculum and how that content is taught, but also by how students from different socio-economic backgrounds progress through the system, how well learning materials match students' skills, and how well teachers understand and manage the diverse learning needs of their students.

What opportunities to learn mathematics are offered to students in Spain?

- In 2012, the average 15-year-old student in Spain spent 3 hours and 30 minutes per week in regular mathematics lessons at school (OECD average: 3 hours and 32 minutes), 34 minutes more per week than the average student spent in 2003 (OECD average: 13 minutes more).
- Students in Spain have heard of algebra concepts (such as exponential function, quadratic function and linear equation) a few times, similar to the OECD average. They have heard of geometry concepts (such as vector, polygon, congruent figure and cosine) more than a few times, slightly more than the OECD average. Overall familiarity with mathematics is among the highest among participating countries and economies.
- Students in Spain reported more frequent exposure at school to pure mathematics tasks (linear and quadratic equations) and to applied mathematics (such as working out from a train timetable how long it would take to get from one place to another) than the OECD average. Exposure to pure mathematics is among the highest among participating countries and economies.



Source: Figure 1.7

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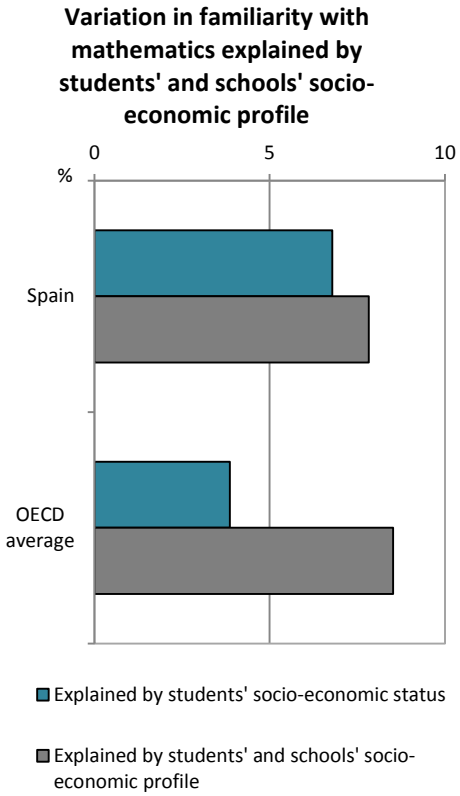
How does access to mathematics vary across students, schools and school systems?

Lack of access to mathematics content at school can leave young people socially and economically disadvantaged for life. Education systems that fail to provide the same learning opportunities to all students can end up reinforcing, rather than beginning to dismantle, the inequalities already present in society. How are opportunities to learn mathematics distributed in Spain?



Source: Figure 2.2

- Girls in Spain are more familiar with mathematics concepts than boys, as on average across OECD countries. Students without an immigrant background are more familiar with mathematics than immigrant students, as is the case on average across OECD countries. Spain is one of the OECD countries where the differences in familiarity between foreign-born students and students without an immigrant background are more marked.
- The overall variation in familiarity with mathematics in Spain is one of the highest among participating countries and economies. Around 8% of the variation in familiarity with mathematics is explained by students' socio-economic status and by the concentration of socio-economically advantaged students in certain schools (OECD average: 9%). In Spain, the socio-economic profile of a school adds little to the effect related to an individual student's socio-economic status, suggesting that disadvantaged students lag behind other students in access to mathematics no matter which school they attend.
- Less than 5% of students in Spain attend schools where a student's academic performance and/or recommendations from feeder schools are always considered for admission. On average across OECD countries, the higher the percentage of students enrolled in selective schools in a country, the less equity in opportunity to learn mathematics in that country.
- Ability grouping in Spain is as prevalent in socio-economically disadvantaged schools as in advantaged schools in Spain. Across OECD countries, ability grouping is not strongly associated with the average student's familiarity with mathematics, but it might limit disadvantaged students' access to advanced mathematics.
- In contrast with most participating countries and economies, disadvantaged schools in Spain have 40 percentage points more qualified mathematics teachers (teachers with a major in mathematics) than advantaged schools. On average across OECD countries, the share of qualified mathematics teachers is eight percentage points larger in advantaged schools than in disadvantaged schools.

What is the relationship between exposure to mathematics in school and performance in PISA?

How is opportunity to learn mathematics related to students' performance in PISA? PISA challenges students to solve problems that might be encountered in real life and that do not necessarily look like the problems presented in mathematics classes at school. Even though PISA data cannot establish cause and effect, by analysing students' exposure to mathematics and how those students perform on different PISA tasks, PISA can provide evidence of whether students can apply the mathematics they learn at school to novel problems.

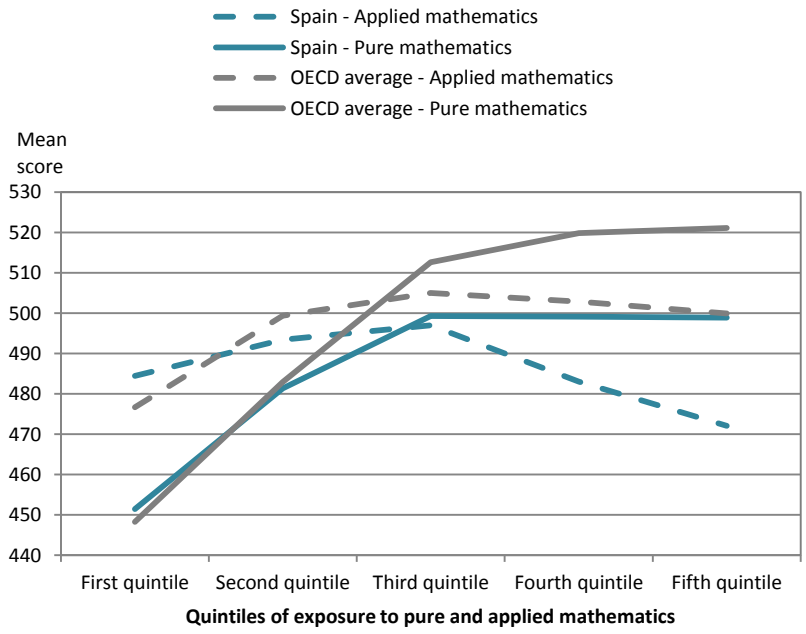
- In Spain, longer instruction time in mathematics is not associated with an improvement in mathematics performance. Also after accounting for the fact that better-performing students may be sorted into schools and

grades providing longer instruction time in mathematics, the analysis does not show a statistically significant relation between the time spent in mathematics classes and the performance in PISA.

- In Spain, exposure to pure mathematics is more strongly related to higher performance than exposure to applied mathematics, as is the case on average across OECD countries. Exposure to pure mathematics is more strongly related to performance increases among lowest-achieving students than among highest-achieving ones. Even after accounting for the fact that better-performing students may attend schools that offer them more mathematics instruction, exposure to pure mathematics is related to higher performance, both in Spain and on average across OECD countries.

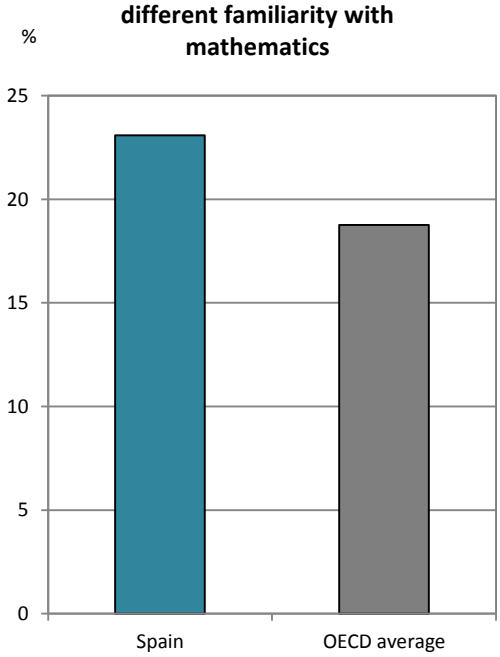
- In Spain, around 23% of the performance difference between socio-economically advantaged and disadvantaged students can be attributed to disadvantaged students' relative lack of familiarity with mathematics concepts (OECD average: 19%).

Performance in mathematics, by exposure to applied and pure mathematics



Source: Figure 3.9

Percentage of the performance difference between advantaged and disadvantaged students explained by different familiarity with mathematics



Source: Figure 3.15

Opportunity to learn, students' attitudes towards mathematics and mathematics performance

If not everyone is born to become a mathematician, everyone needs to be able to reason mathematically. Positive feelings towards mathematics and the ability to solve mathematics problems are closely interconnected. That is why it is important to nurture positive attitudes towards mathematics among students of all ages.

- In Spain, 60% of students report they are interested in the things they learn in mathematics (OECD average 53%).

- In Spain, greater exposure to complex mathematics concepts, as measured by the *index of familiarity with mathematics*, is associated with less self-confidence (lower self-concept) in mathematics, while greater exposure to applied mathematics is associated with higher self-confidence, after accounting for students' mathematics performance.

- On average across OECD countries, including Spain, greater exposure to both applied and pure mathematics is associated with greater mathematics anxiety, after accounting for students' mathematics performance.

- Students in Spain who reported less familiarity with mathematics than the average student in their school have lower mathematics self-concept (as on average across OECD countries), meaning that their self-concept may be undermined by social comparisons with peers who have a greater familiarity with mathematics.

- Students in Spain whose parents do not like mathematics are 43% more likely to feel helpless when doing a mathematics problem than students whose parents like mathematics.

Giving all students similar opportunities to learn mathematics

How can all students be helped to understand mathematical ideas, compute fluently, engage in logical reasoning and communicate using mathematics? One way is to ensure that all students learn core mathematics concepts and learn how to solve challenging mathematics tasks at school.

A policy strategy centred on giving all students similar opportunities to learn mathematics can reduce the number of students who lack the knowledge and understanding of mathematics expected of 15-year-olds and could ultimately result in greater social mobility. Such a general strategy for countries participating in PISA would include:

- **Developing coherent standards, frameworks and instruction material for all students**, to increase focus and connections between topics in the curriculum and to set the same expectations for all students.

- **Helping students acquire mathematical skills beyond content knowledge** by supporting teachers in including problem solving in mathematics classes.

- **Addressing heterogeneity in the classroom**, by offering individualised support to struggling students and by providing pedagogical training to teachers on how to handle students with different abilities in the same class.

- **Promoting positive attitudes towards mathematics through innovations in the curriculum and teaching**, by creating and using engaging tasks and giving feedback to struggling students.

- **Monitoring and analysing opportunity to learn**, by collecting and analysing data on the mathematics content and the teaching methods to which students are exposed.

To learn more, see…

OECD (2016), *Equations and Inequalities: Making Mathematics Accessible to All*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264258495-en