Equations and Inequalities: Making Mathematics Accessible to All

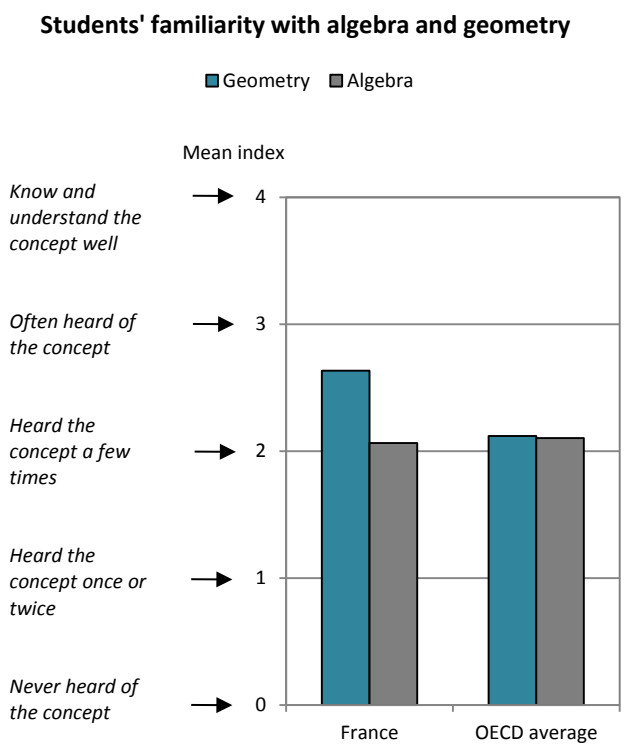
Country note France

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. In France, more than 20% of employees use algebra at work, and people with high numeracy skills are 80% more likely to earn high wages than the average worker. But proficiency in numeracy 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 France?

- In 2012, the average 15-year-old student in France spent 3 hours and 27 minutes per week in regular mathematics lessons at school (OECD average: 3 hours and 32 minutes), the same as in 2003 (OECD average: 13 minutes more).
- Students in France 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, more than the OECD average.
- Students in France reported as frequent exposure at school to pure mathematics (linear and quadratic equations) as on average across the OECD; they reported less frequent exposure to applied mathematics tasks (such as working out from a train timetable how long it would take to get from one place to another) than the OECD average.



Source: Figure 1.7

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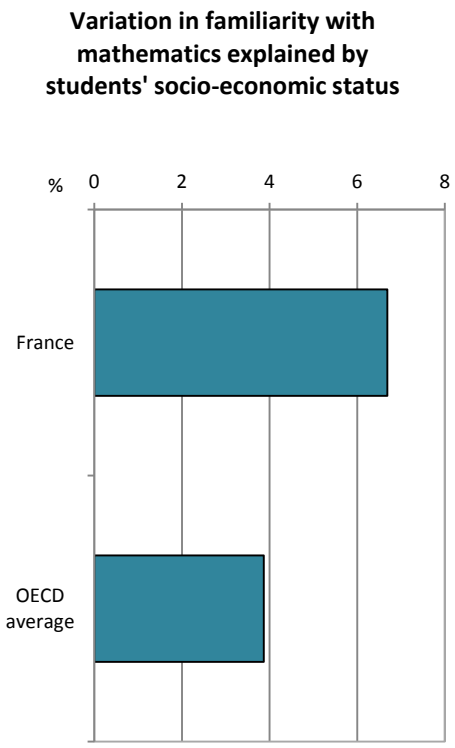
How does access to mathematics vary across students, schools and school systems?

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 France?

In France, as on average across OECD countries, students' socio-economic profile is strongly related to students' access to opportunities to learn mathematics. Vertical stratification (related to grade repetition) and horizontal stratification (related to sorting students between schools) are also associated with more unequal opportunities to learn.



Source: Figure 2.2

- Girls in France 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.
- In France, around 7% of the variation in familiarity with mathematics is explained by students' socio-economic status (OECD average: about 4%). Some 70% of students whose parents have tertiary education know well or have often heard the concept of quadratic function, but only 42% of children of primary educated parents report so.
- About 28% of students in France report to have repeated a grade at least once. On average across OECD countries, the higher the percentage of students who repeated a grade, the less equity in opportunity to learn mathematics in that country.
- France starts tracking students at 15 and about 15% of PISA students attend vocational schools. The relationship between students' socio-economic status and their familiarity with mathematics is significantly stronger for students attending upper secondary school compared to their peers in lower secondary schools
- Students in France who attend vocational schools are about twice as likely to be socio-economically disadvantaged and more than twice as likely to be less familiar with mathematics as students who attend academically oriented schools.
- In France, over 26% of students attend schools where principals believe that ability differences within classes hinder learning a lot (OECD average: 11%); this is one of the highest percentages across all PISA countries and economies.
- Less than half (46%) of students in France attend schools where teachers believe that it is best to adapt academic standards to students' levels and needs (OECD average: 70%). Students in France are also much less likely than in other OECD countries to have mathematics teachers who assign different tasks to students based on ability.

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

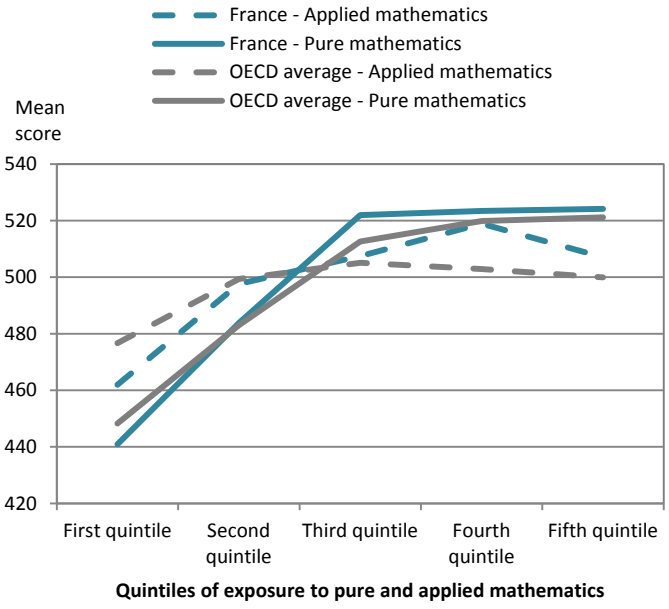
How is opportunity to learn mathematics related to students' performance in PISA? PISA challenges students to solve problems that might be encountered in real life and that do not necessarily look like the problems presented in mathematics classes at school. Even though PISA data cannot establish cause 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 France, longer instruction time in mathematics of up to six hours per week is associated with an improvement in mathematics performance. But after accounting for the fact that better-performing students may be sorted into schools and grades providing longer instruction time in mathematics, an increase in instruction time has no statistically significant impact on performance.

- In France, 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. 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 France and on average across OECD countries.

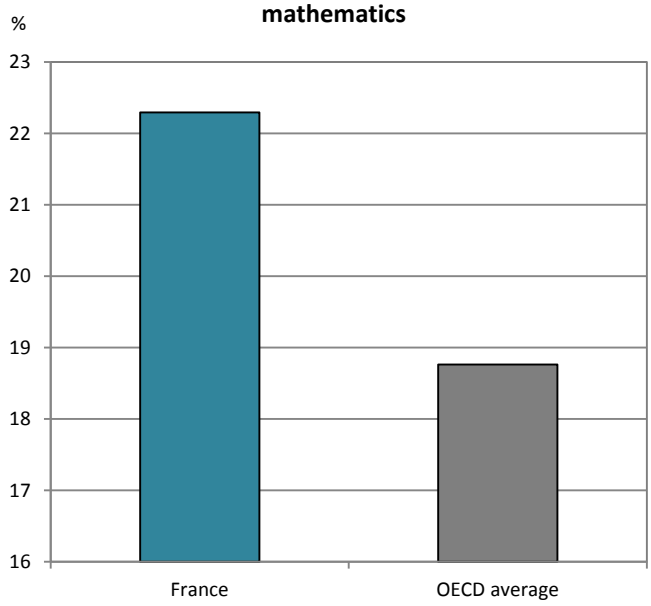
- In France, about 22% of the performance difference between socio-economically advantaged and disadvantaged students can be attributed to disadvantaged students' relative lack of familiarity with mathematics concepts (OECD average: 19%).

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 France, 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 and more mathematics anxiety, after accounting for students' mathematics performance.

- On average across OECD countries, low-performing students reported greater anxiety when they are more exposed to pure mathematics tasks, such as solving linear and quadratic equations. In France, both high- and low-performing students reported greater anxiety in relation to greater exposure to pure mathematics.

- High-performing students in France who reported that their parents do not like mathematics are more than twice as likely to feel helpless when they are doing mathematics problems as the high-performing children of parents who 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 strategy 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.

- **Reducing the impact of tracking on equity in exposure to mathematics** by postponing the age at which students are first tracked, allowing students to change tracks, and increasing the quantity and improving the quality of the mathematics taught in vocational tracks.

- **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