



Equations and Inequalities: Making Mathematics Accessible to All

Country note Italy

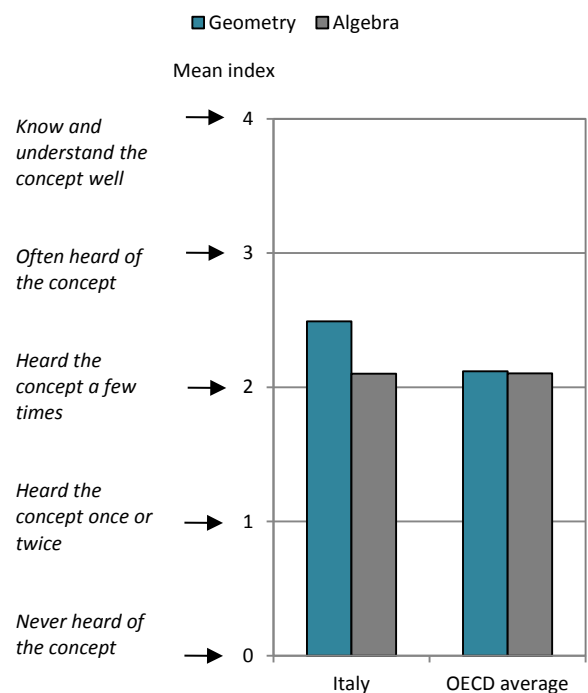
Numeracy skills are used daily in many jobs, and proficiency in numeracy is important for a wide range of outcomes in adult life, from employment to health and civic participation. But proficiency in mathematics involves more than the ability to make simple calculations; people also need to be able to 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 Italy?

- In 2012, the average 15-year-old student in Italy [spent 3 hours and 52 minutes per week in regular mathematics lessons at school](#) (OECD average: 3 hours and 32 minutes), 19 minutes more per week than the average student spent in 2003 (OECD average: 13 minutes more).
- [Students in Italy 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. Students in Italy do relatively better in PISA tasks requiring knowledge of the geometric concepts of space and shape than on tasks requiring the application of algebra to describe and predict change.
- Students in Italy reported [more frequent exposure at school to pure mathematics](#) (linear and quadratic equations) than to applied mathematics tasks (such as working out from a train timetable how long it would take to get from one place to another). Italy is among the ten PISA countries and economies with the highest exposure to tasks including equations.

Students' familiarity with algebra and geometry



Source: Figure 1.7

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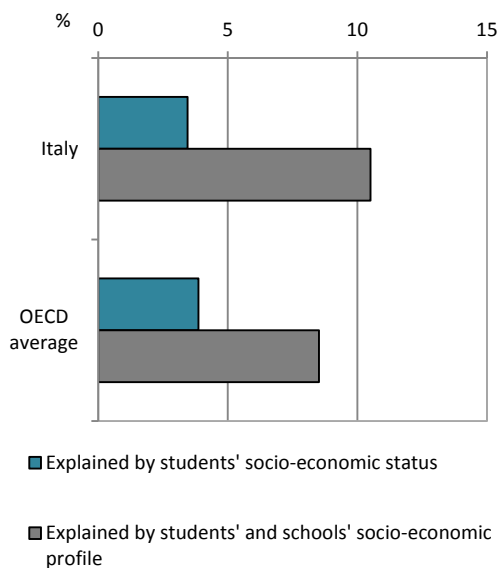


How does access to mathematics vary across students, schools and school systems?

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 Italy?

In Italy, as on average across OECD countries, students' and schools' socio-economic profile is strongly related to students' access to opportunities to learn mathematics. Stratification between and within schools is also associated with more unequal opportunities to learn.

Variation in familiarity with mathematics explained by students' and schools' socio-economic profile



- Girls in Italy 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 Italy, [around 11% 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 Italy, [the relationship between students' socio-economic status and their familiarity with mathematics is similar regardless of whether students attend lower or upper secondary school](#)
- About half of 15-year-old students in Italy attend a vocational school. Students in Italy who attend vocational schools are [almost three times 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.

Source: Figure 2.2

- [About three out of four students in Italy are in schools with ability grouping](#) for some or all classes. Ability grouping is as prevalent in socio-economically advantaged schools as in disadvantaged schools in Italy. Across OECD countries, [ability grouping is not strongly associated with the familiarity with mathematics of the average student](#), but might reduce disadvantaged students' access to advanced mathematics.
- More than 60% of students in Italy 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](#).

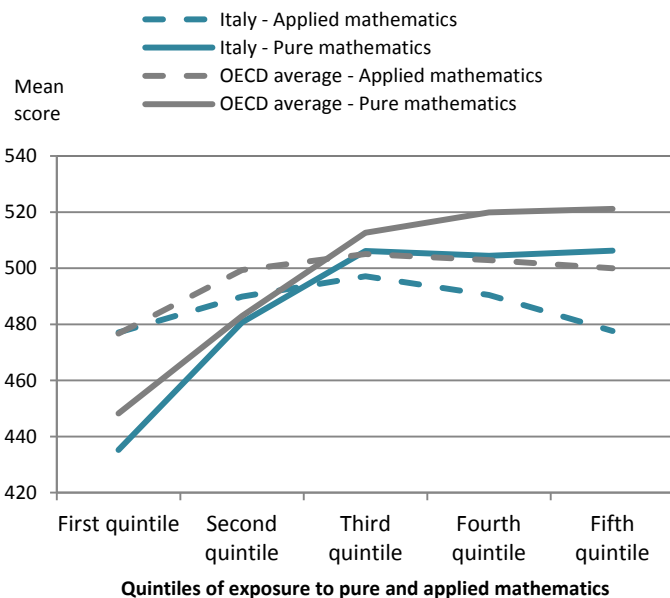
What is the relationship between exposure to mathematics in school and performance in PISA?

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.



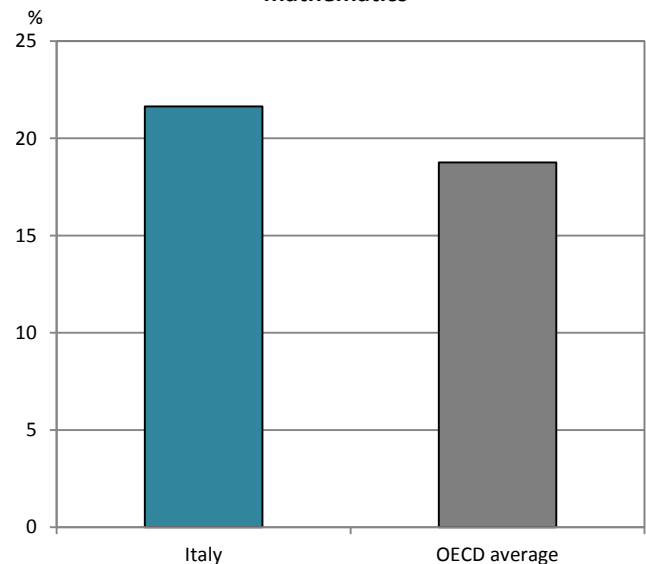
- In Italy, [longer instruction time in mathematics](#) of up to six hours per week is associated with an improvement in mathematics performance. Moreover, an increase in instruction time has a statistically significant positive impact on performance [even after accounting for the fact that better-performing students may be sorted into schools and grades providing longer instruction time](#) in mathematics .
- In Italy, [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 Italy and on average across OECD countries.
- In Italy, [around 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

How are opportunity to learn, students' attitudes towards mathematics and mathematics performance related?

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 Italy, [57% of the students report that they are interested in the things they learn in mathematics](#) (OECD average 53%), 3 percentage points less than in 2003.
- In Italy, 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 with more mathematics anxiety, after accounting for students' mathematics performance.
- On average across OECD countries, including Italy, greater exposure to both applied and pure mathematics is associated with [greater mathematics anxiety among low-performing students](#) . These students might not have acquired basic mathematics skills and might feel incapable of solving the problems presented in class.



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>