Equations and Inequalities: Making Mathematics Accessible to All

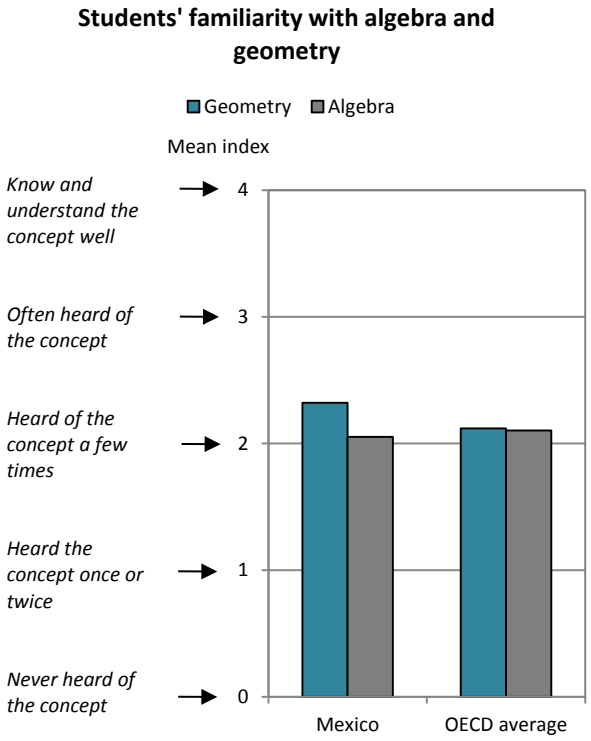
Country note Mexico

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 Mexico?

- In 2012, the average 15-year-old student in Mexico spent 4 hours and 13 minutes per week in regular mathematics lessons at school (OECD average: 3 hours and 32 minutes), 18 minutes more per week than the average student spent in 2003 (OECD average: 13 minutes more).
- Students in Mexico have heard of algebra concepts (such as exponential function, quadratic function and linear equation) and of geometry concepts (such as vector, polygon, congruent figure and cosine) a few times, about the same as the OECD average. Overall familiarity with mathematics is lower than the OECD average.
- Students in Mexico reported less frequent exposure to pure mathematics (linear and quadratic equations) than the OECD average and more frequent exposure than the OECD average to applied mathematics tasks (such as working out from a train timetable how long it would take to get from one place to another).



Source: Figure 1.7

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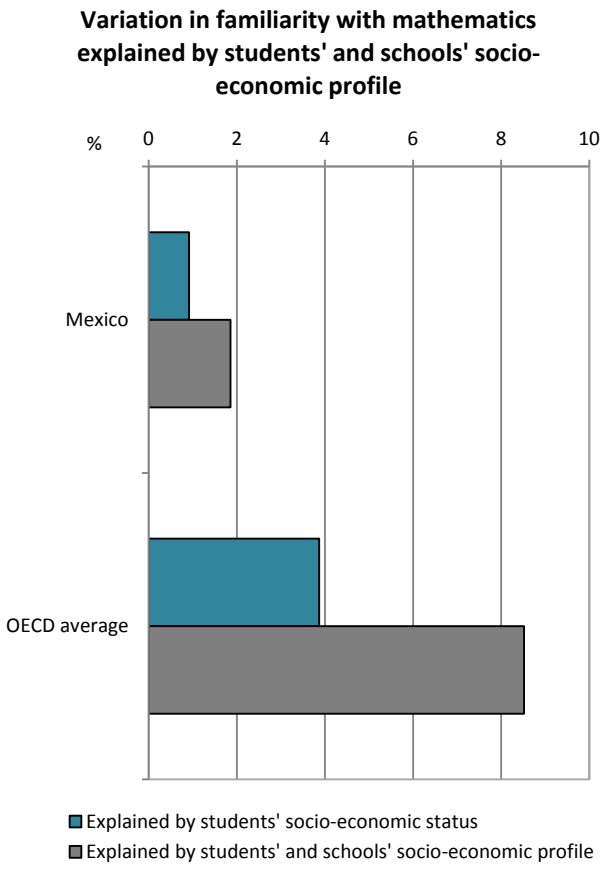
How does access to mathematics vary across students, schools and school systems?

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 Mexico?

In Mexico, students' and schools' socio-economic profile is less strongly related to students' access to opportunities to learn mathematics than on average across OECD countries. Stratification within schools appears to be more strongly associated with unequal opportunities to learn than stratification between schools.



Source: Figure 2.2

- Girls in Mexico are more familiar with mathematics concepts than boys, as on average across OECD countries.
- In Mexico, 2% 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%).
- Mexico first tracks students at the age of 15. PISA 2012 data show that early tracking into academic or vocational programmes is related to inequalities in opportunities to learn mathematics. On average across OECD countries, the earlier the students' age at first tracking in a country, the less equity in opportunity to learn mathematics in that country.
- About 25% of 15-year-old students attend a vocational school. Students in Mexico who attend vocational schools are as likely to be socio-economically disadvantaged and to be less familiar with mathematics as students who attend academically oriented schools.
- In Mexico, the difference in the relationship between students' socio-economic status and their familiarity with mathematics is not significantly different between students attending upper secondary school and their peers in lower secondary school.
- Ability grouping is more prevalent in socio-economically disadvantaged schools than in advantaged schools by 12 percentage points in Mexico. In addition, ability grouping is negatively associated with students' familiarity with mathematics, also after accounting for students' and schools' socio-economic profile.
- About 51% of students in Mexico 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 .
- Teachers in socio-economically advantaged schools in Mexico are more likely to use cognitive activation strategies - such as giving problems with no immediate solution or asking students to apply what they learnt in new context - than teachers in disadvantaged schools.

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

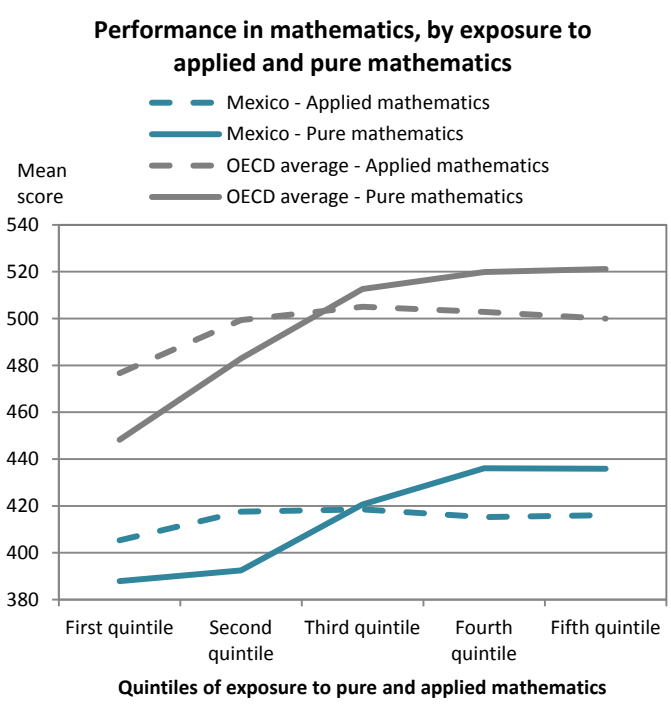
How is opportunity to learn mathematics related to students' performance in PISA? PISA challenges students to solve problems that might be encountered in real life and that do not necessarily look like the problems presented in mathematics classes at school. Even though PISA data cannot establish cause 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.

- The performance in mathematics of Mexican students increased across all the mathematics content areas between 2003 and 2012 except in *space and shape*, which requires knowledge of geometry and includes some of the most difficult PISA tasks.

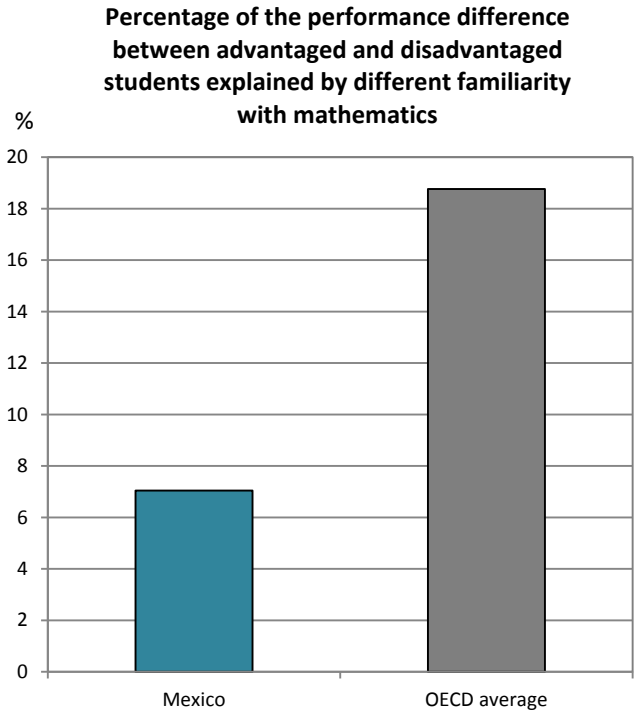
- In Mexico, longer instruction time in mathematics of up to six hours per week is associated with an improvement in mathematics performance.Students who attend less than two hours per week of mathematics classes score 48 points less than students who attend between two and four hours per week. However, 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 does not show a statistically significant positive impact on performance .

- In Mexico, exposure to pure mathematics is more strongly related to higher performance than exposure to applied mathematics, similarly to the average of OECD countries. However, after accounting for the fact that better-performing students may attend schools that offer them more mathematics instruction, more exposure to pure mathematics is not significantly associated with higher scores in Mexico (OECD average: greater exposure to pure mathematics is associated with higher performance after accounting for the selection of better students in better schools).

- In Mexico, 7% 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%).



Source: Figure 3.9



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.

- The percentage of students who reported that they enjoy mathematics increased by about 8 percentage points between 2003 and 2012 in Mexico (OECD average: no change).

- In Mexico, 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, after accounting for students' mathematics performance.

- To the extent that attending a school with highly motivated peers creates incentives for students to work on mathematics, disadvantaged students can be expected to benefit from attending advantaged schools. However, students in Mexico who reported less familiarity with mathematics than the average student in the 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.

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