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PISA in Focus

How much do 15-year-olds learn over one year of schooling?

Programme for International Student Assessment

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How much do 15-year-olds learn over one year of schooling?

- On average across countries and economies, 15-year-old students' reading, mathematics and science scores increased by about one-fifth of a standard deviation over one year prior to the COVID-19 pandemic.
- The learning gain over a school year tends to be larger for students in high-income countries and economies compared to students in middle-income countries and economies.
- In reading, the estimates for individual countries and economies range from fewer than 10 score points in Albania, Belarus, Israel, Korea and Chinese Taipei to 25 score points or more in Austria, Costa Rica, Estonia, Germany, Luxembourg, Scotland (United Kingdom), the Slovak Republic, Switzerland and the United Kingdom (excluding Scotland).
- The difference in mean PISA reading scores between Estonia (523 points) and Germany (498 points) is about equivalent to the learning gain that students make over one year in these countries.

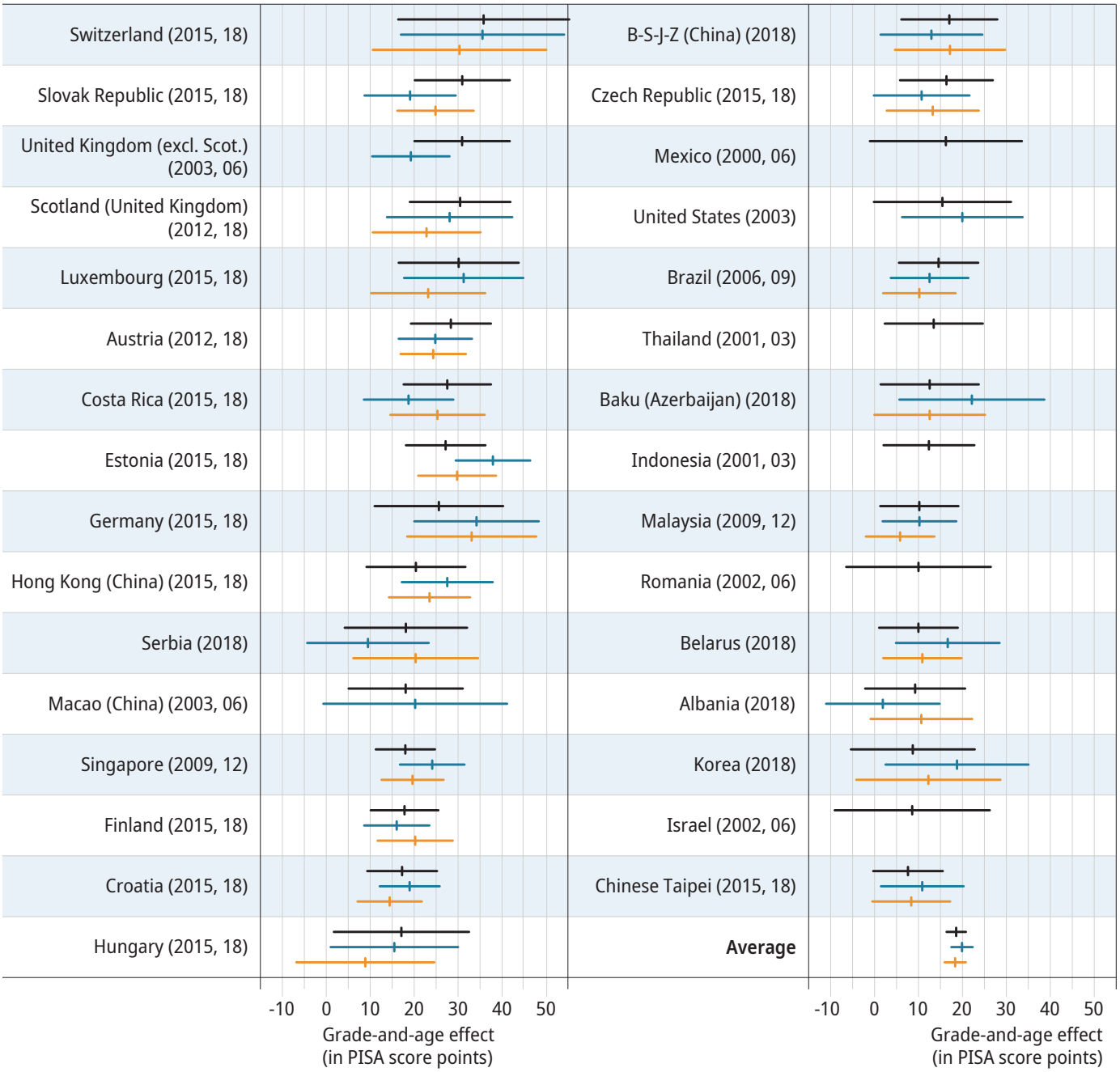
In 2020 and 2021, schooling, like many other aspects of life, has been heavily affected by the ongoing coronavirus pandemic. During periods of school closure, education systems and schools have often been quick to organise remote support for home-based learning. But several observers have questioned the effectiveness of these schooling surrogates, either in general or for particular types of students. Initial data from national assessments[1] confirm, indeed, that the results of many students who experienced school closures (particularly those from disadvantaged backgrounds) lag behind those of similar students in previous school years.

Learning losses and gains are often compared to the typical learning progression observed in normal times over a year of schooling. But until recently, such a benchmark was only available at the local or national level, if at all. An internationally comparable measure of the average learning progressions, expressed in a metric available to multiple countries, did not exist.

On average, what students learn over a school year corresponds to about 20 score points in PISA

Two recent working papers[2] address the challenges of using international assessments such as PISA to estimate the average yearly learning gain of students, using two distinct strategies. Based on the PISA data sets from 2018 and earlier assessments of more than 30 countries and economies, these studies show that, on average, students' test scores increase by about one-fifth of a standard deviation over a "normal" school year (or about 20 score points in PISA) (Figure 1).

The learning gain over one year of schooling in 31 countries and economies



Note: The figure reports estimates of the effect of one year of age and of schooling on reading (black), mathematics (blue) and science (yellow) scores. For countries whose estimates are based on earlier cycles of PISA, the learning gain in mathematics and/or science could not always be estimated. The horizontal line represents the statistical uncertainty associated with each point estimate, and connects the upper and lower bound of a 95% confidence interval. Years of data are indicated in parentheses.

Countries and economies are ranked in descending order of the estimated grade-and-age effect in reading.

Source: Tables 4.1 and A.2 in Avvisati and Givord (2021a) and Table 5.1 in Avvisati and Givord (2021b).

Box 1. Two strategies to identify the learning gain in PISA

In order to quantify average yearly learning progressions in PISA, several challenges need to be overcome: PISA, indeed, does not track students over time; and while the current grade level attended by 15-year-olds may vary, this variation is related to unobserved determinants of proficiency such as prior performance or students' health. This may confound a naïve comparison of students' scores in different grades.

The first working paper addresses these challenges by focusing on the few countries and economies that changed the time of the year when PISA was conducted. In PISA, the target population is defined by a 12-month range of age: the birthdates of eligible students depend on the testing date. If the testing date changes (as was the case, for example, in Austria in 2015 and in Scotland in 2018), the month of birth of the eldest eligible students also changes. When grouping students by month of birth, two groups can be defined such that the change in testing date has opposite effects on their age and length of schooling. If the new testing date is at an earlier time in the school year, students born in certain months are assessed at a younger age and at an earlier point in their school career than would have been the case had the testing date remained the same. In contrast, students born in the remaining months are assessed at an older age and at the beginning of the following grade. The change in testing date thus acts as an exogenous source of variation that allows for the identification of the full effect of a year of schooling and of age through a difference-in-difference estimator.

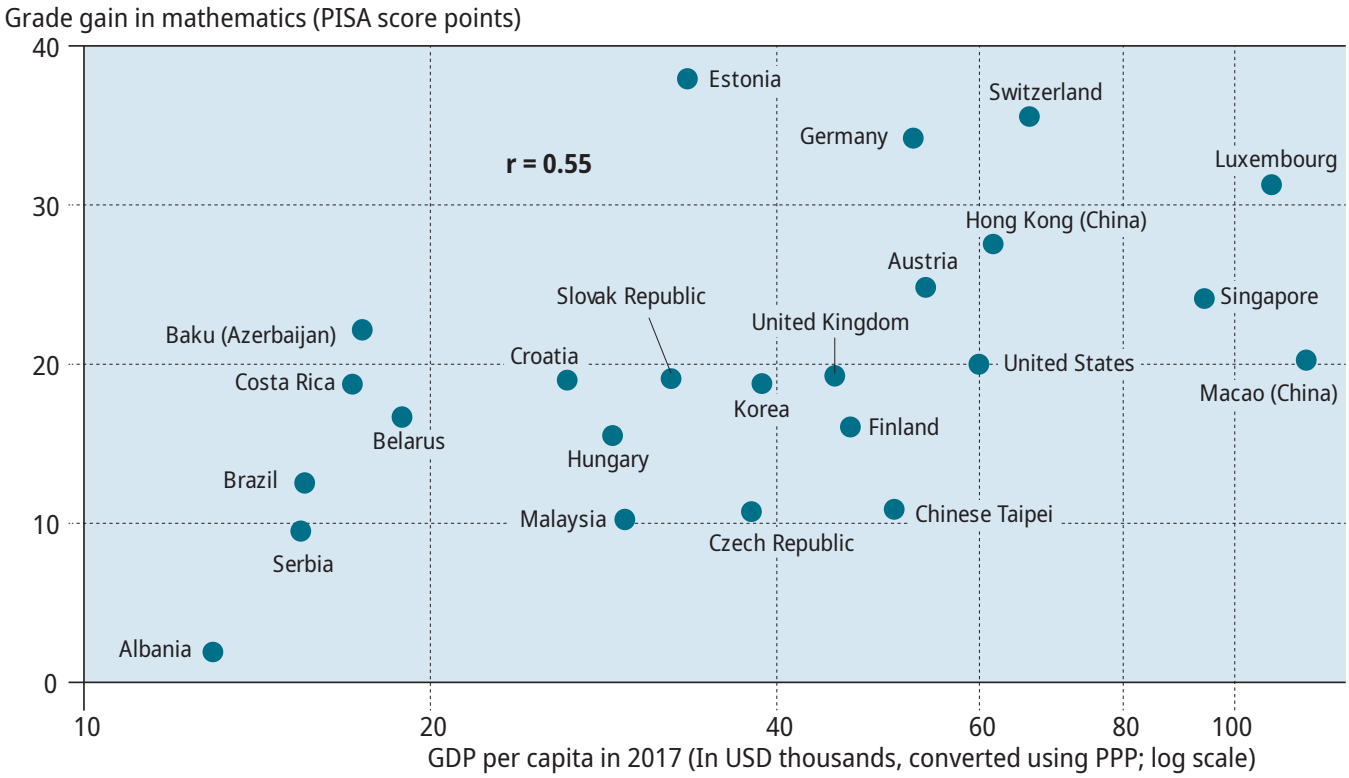
The second working paper addresses these challenges by exploiting the exogenous source of variation in students' grade and age at school entry resulting from school-entry regulations in countries where the PISA cohort does not coincide with a single school-entry cohort. The intuition is to compare the results in PISA of the eldest and youngest students in the PISA cohort – which are both (almost) one year of age apart and expected to be (given school-entry regulations) one grade level apart. Importantly, in these countries, the eldest and the youngest students in PISA were about the same age when they started primary school, meaning that any difference observed in their scores is not confounded by differences in school starting age.

In reading, the estimates for individual countries and economies range from fewer than 10 score points in Albania, Belarus, Israel, Korea and Chinese Taipei to 25 score points or more in Austria, Costa Rica, Estonia, Germany, Luxembourg, Scotland (United Kingdom), the Slovak Republic, Switzerland and the United Kingdom (excluding Scotland), with similar variation in mathematics and science too. However, comparisons of the grade gain across countries must also take into account the large uncertainty associated with these estimates. This means that it is in most cases not possible to conclude that the grade gain in one country/economy is larger than the grade gain in another country/economy except for a few country/economy pairs.

Some countries and economies with large estimated grade gains such as Estonia also have high average scores in PISA; but overall, the association between grade-and-age effects and mean performance is weak. The weak correlation may be due to the large statistical uncertainty around grade-gain estimates, which results in attenuated correlations. At the same time, the comparatively small grade gains for some high-performing countries/economies could indicate that strong PISA results in those countries and economies mostly reflect an advantage gained in the early grades. For example, the Czech Republic, Finland, Korea and Chinese Taipei were among the highest-performing countries and economies in 2011 in the Trends in International Mathematics and Science Study (TIMSS) for fourth-grade students[3]. The assessed cohort was in between the cohorts assessed in PISA 2015 and 2018.

A somewhat stronger association is observed between estimated grade gains and gross domestic product (GDP) per capita. The average grade gain among high-income countries, in other words, is larger than the average grade gain among middle-income countries participating in PISA.

Grade effects in PISA and GDP per capita in 24 countries and economies



Note: The GDP figure for Baku (Azerbaijan) refers to all of Azerbaijan; the grade gain in mathematics for the United Kingdom refers to the United Kingdom, excluding Scotland.
Source: Tables 4.1 and A.2 in Avvisati and Givord (2021a), Table 5.1 in Avvisati and Givord (2021b), and International Monetary Fund, *World Economic Outlook Database*, https://www.imf.org/en/Publications/WEO/weo-database/2019/April.

The bottom line

Knowing the typical learning gain that students make as they progress from one grade-level to the next is of great value for interpreting PISA results. Estimates of the grade gain can be used as a benchmark to gauge the significance of gender gaps, socio-economic gaps and between-country differences. Similar estimates have also been used to project the economic impacts of learning losses due to school closures.[4] Indeed, if students do not acquire new skills during periods of school closures and no remedial action is taken after such periods, affected students will suffer from lower skill levels as they enter adulthood. How severely this impacts the economy in the longer term depends on a number of factors, including the duration of school closures and the size of the typical annual learning gain prior to such closures. In this respect, countries and economies where the average yearly learning gains for students were the largest prior to the pandemic face the highest cost when closing schools.

Notes

1. See, for example, the results of national assessments in France (https://www.education.gouv.fr/evaluations-2020-reperes-cp-ce1-premiers-resultats-307122; https://www.education.gouv.fr/evaluations-2021-point-d-etape-cp-premiers-resultats-322673, https://www.education.gouv.fr/media/72887/download) and Italy (https://invalsi-areaprove.cineca.it/docs/2021/Rilevazioni_Nazionali/Rapporto/14_07_2021/Sintesi_Primi_Risultati_Prove_INVALSI_2021.pdf) and of regional assessments in Germany (Baden-Württemberg, https://doi.org/10.31234/osf.io/pqtgf). Similar evidence, often based on non-representative samples, is also available for Australia (New South Wales, https://doi.org/10.1007/s13384-021-00436-w) and for Belgium, the Netherlands, the United Kingdom and the United States, as summarised by the Education Endowment Foundation (https://educationendowmentfoundation.org.uk/eef-support-for-schools/covid-19-resources/best-evidence-on-impact-of-school-closures-on-the-attainment-gap/). It must be noted that while the finding of widening socio-economic gaps is common, not all studies, particularly those based on representative samples, report an average learning loss across *all* students.

2. Avvisati, F. and P. Givord (2021a), "The learning gain over one school year among 15-year-olds: An analysis of PISA data for Austria and Scotland (United Kingdom)", *OECD Education Working Papers*, No. 249, OECD Publishing, Paris, https://doi.org/10.1787/d99e8c0a-en, and Avvisati, F. and P. Givord (2021b), "How much do 15-year-olds learn over one year of schooling? An international comparison based on PISA", *OECD Education Working Papers*, No. 257, OECD Publishing, Paris, https://doi.org/10.1787/a28ed097-en.

3. Mullis, I. et al. (2012), *Timss 2011 International Results in Mathematics*, TIMSS & PIRLS International Study Center and International Association for the Evaluation of Educational Achievement (IEA), https://timssandpirls.bc.edu/timss2011/international-results-mathematics.html.

4. Hanushek, E. and L. Woessmann (2020), "The economic impacts of learning losses", *OECD Education Working Papers,* No. 225, OECD Publishing, Paris, https://doi.org/10.1787/21908d74-en.

For more information

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